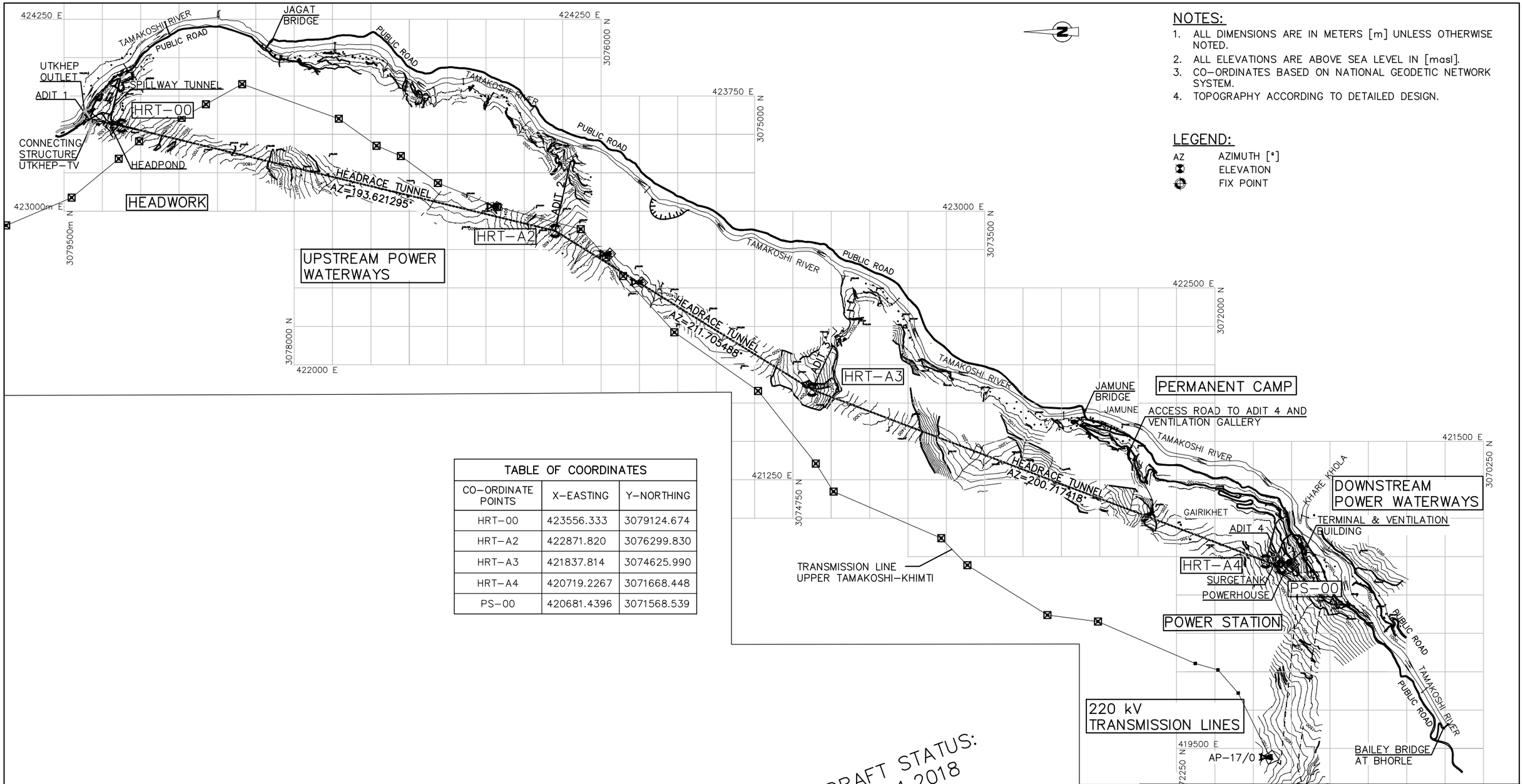


NOTES:

1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO-ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM.
4. TOPOGRAPHY ACCORDING TO DETAILED DESIGN.

LEGEND:

AZ AZIMUTH [°]
ELEVATION
FIX POINT

TABLE OF COORDINATES		
CO-ORDINATE POINTS	X-EASTING	Y-NORTHING
HRT-00	423556.333	3079124.674
HRT-A2	422871.820	3076299.830
HRT-A3	421837.814	3074625.990
HRT-A4	420719.2267	3071668.448
PS-00	420681.4396	3071568.539

DRAFT STATUS:
08.11.2018

SCALE
-250 0 250 500 750 1000 1250 [m]
1:25,000

Reference Drawings	
Drwg. No.	Title
31-00053-DD-4300-N-1012	GENERAL PROJECT INFORMATION, OVERALL PROJECT LAYOUT, TV HEP

Revisions			
	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	Prashant	07.02.18
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No: .....

CAD- File No.:

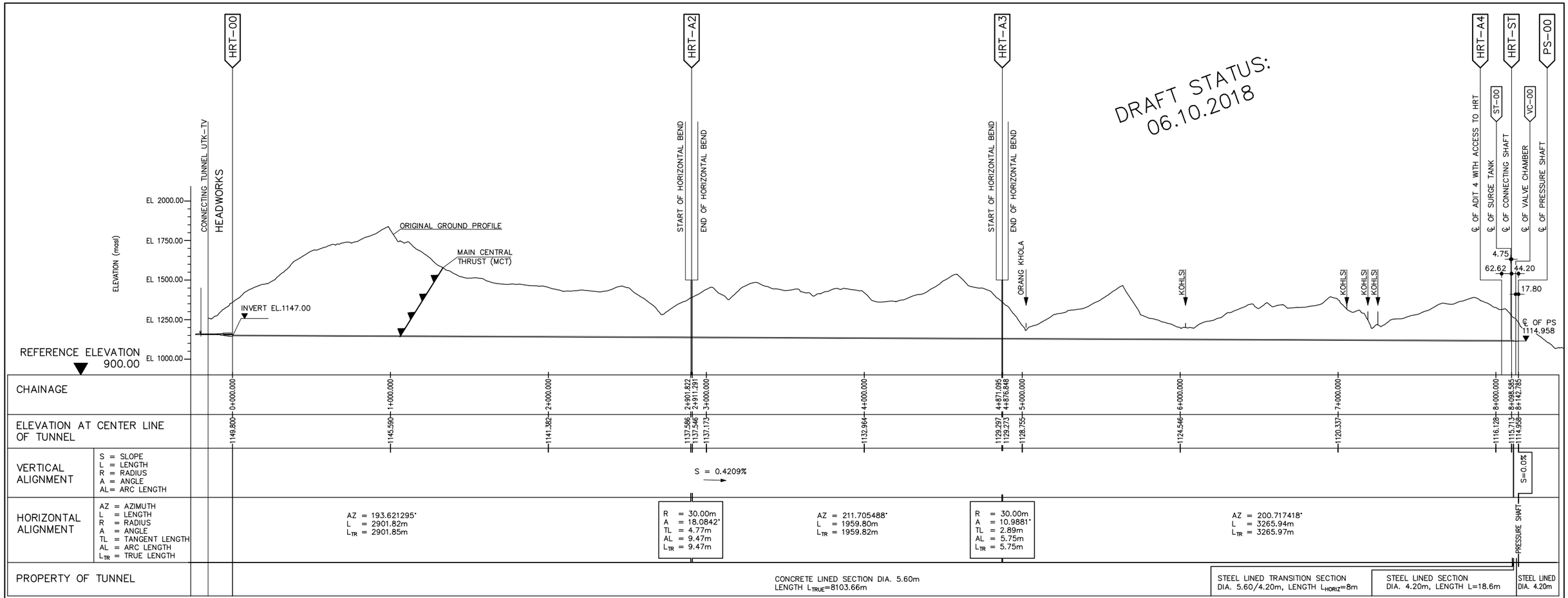
DETAILED DESIGN

UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL

LAYOUT
PROJECT DRAWING

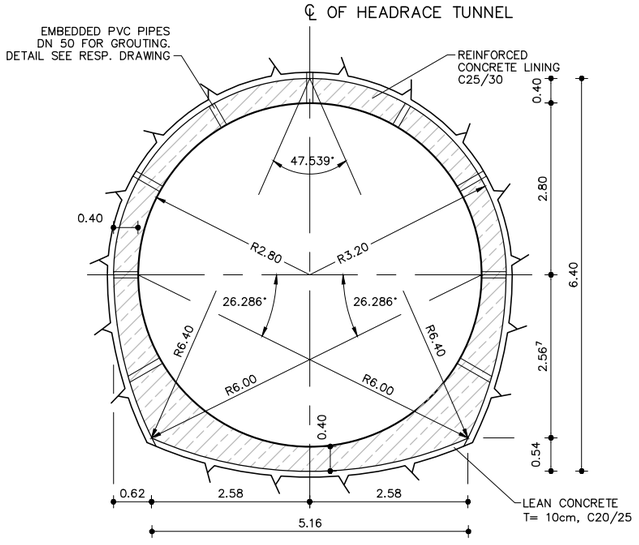
Scale A3: 1:25,000

Drwg. No.: 31-00053-DD-4312 Q 1260 REV. -



SCALE 1:25,000
−250 0 250 500 750 1,000 1,250 [m]

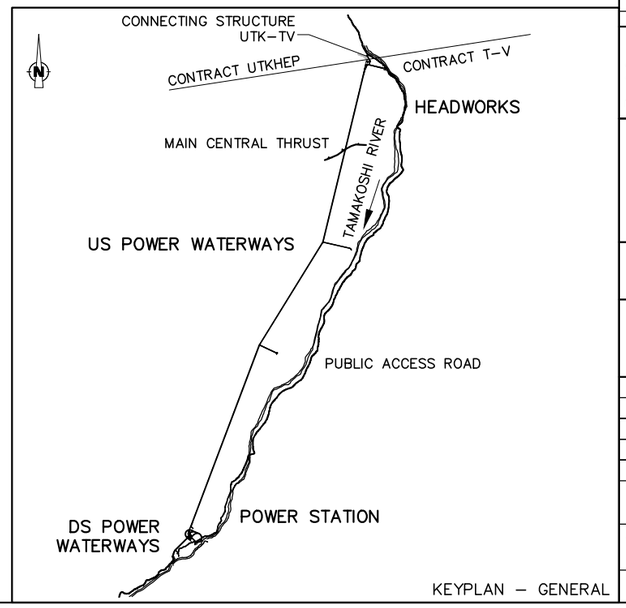
SCALE 1:100
−1 0 1 2 3 4 5 [m]



TYPICAL SECTION
HEADRACE TUNNEL
SCALE 1:100

NOTES:
1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO−ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).

LEGEND:
AZ AZIMUTH [°]
ELEVATION
FIX POINT
CONCRETE CLASS C1 − CONCRETE C25/30
CONCRETE CLASS F − BLINDING CONCRETE C12/15
CONSTRUCTION JOINTS
UNFINISHED TOP OF SLAB
FINISHED FLOOR LEVEL



KEYPLAN − GENERAL

Reference Drawings

Drwg. No.	Title
31−00053−DD−4312−Q−1260	US POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT

Revisions	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	31.07.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No:
31−00053−DD−4312−Y−0000_−

CAD− File No.:

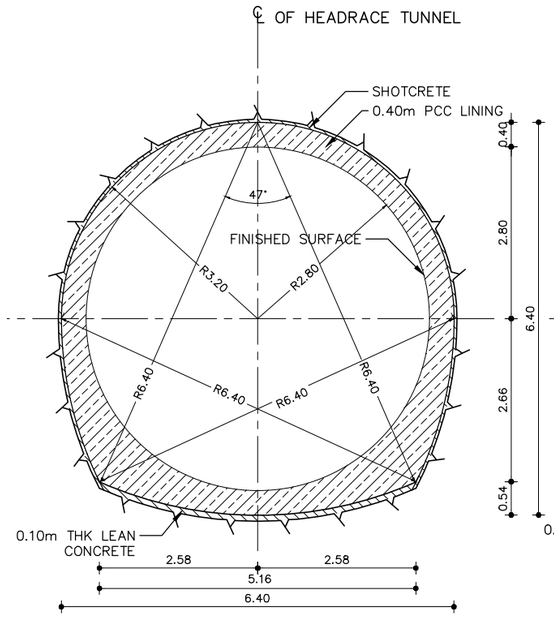
DETAILED DESIGN

U/S POWER WATERWAYS
HEADRACE TUNNEL
LONGITUDINAL SECTION

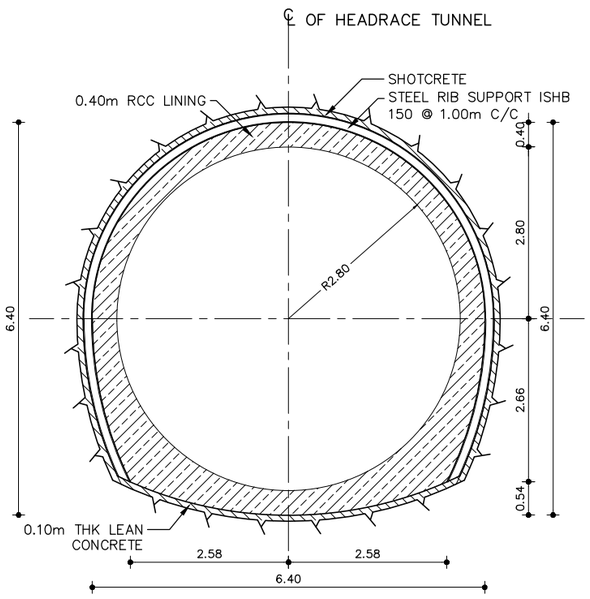
PROJECT DRAWING

Scale A3: 1:25000, 1:100

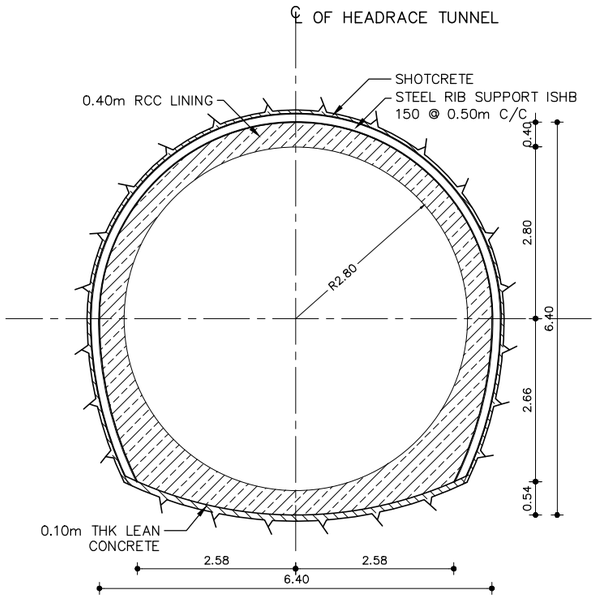
Drwg. No.: 31−00053−DD−4312− Q 1261 REV. −



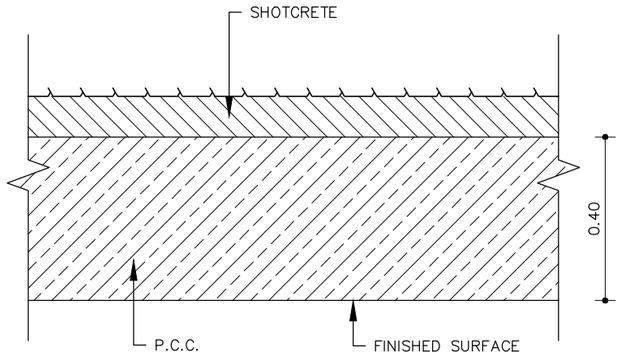
TYPICAL DETAILS OF CONCRETE LINING
FOR ROCK CLASS II, III & IV



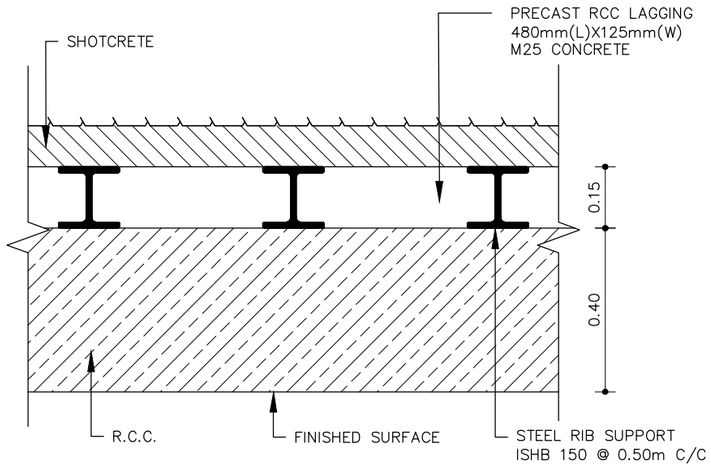
TYPICAL DETAILS OF CONCRETE LINING
FOR ROCK CLASS V



TYPICAL DETAILS OF CONCRETE LINING
FOR ROCK CLASS VI



LINING DETAILS WITHOUT STEEL RIB SUPPORT
NOT TO SCALE



LINING DETAILS WITH STEEL RIB SUPPORT
NOT TO SCALE

DRAFT STATUS:
27.09.2018

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING. ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THIS DRAWING SHOWS ONLY THE DETAILS OF CONCRETE LINING IN HEADRACE TUNNEL.
4. CONCRETE FOR LINING SHALL BE M30 (C25/30) GRADE CONFORMING TO IS: 456–2000.
5. PCC = PLAIN CEMENT CONCRETE, RCC = REINFORCED CEMENT CONCRETE
6. IN OVER EXCAVATED AREAS BACKFILL CONCRETE M15 SHALL BE PLACED OR AS DIRECTED BY ENGINEER.

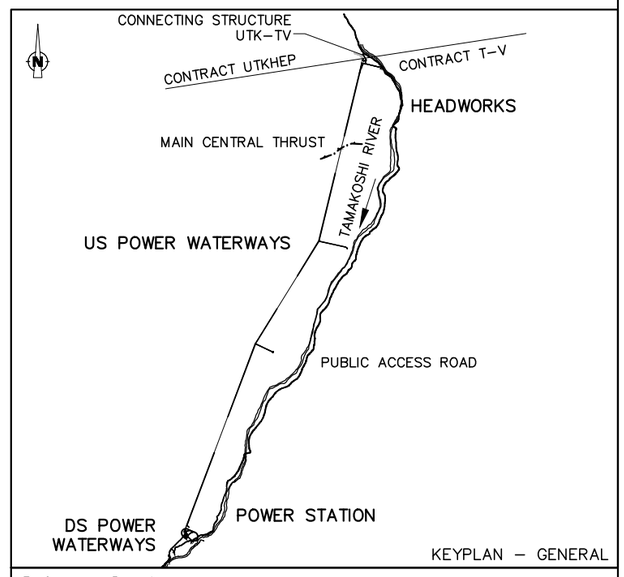
LEGEND:

CONCRETE CLASS C1 – CONCRETE C25/30

CONCRETE CLASS F – BLINDING CONCRETE C12/15

SCALE 1:100

–1 0 1 2 3 4 5 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31–00053–DD–4312–Q–1260	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT
31–00053–DD–4312–Q–1261	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LONGITUDINAL SECTION

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	27.09.18
Drawn	A. K. Basu	27.09.18
Checked	Roloff	27.09.18
Approved	Dr. Moeller	27.09.18

Replaces Drwg. No:
31–00053–DD–4364–Y–0000_–

CAD– File No.:

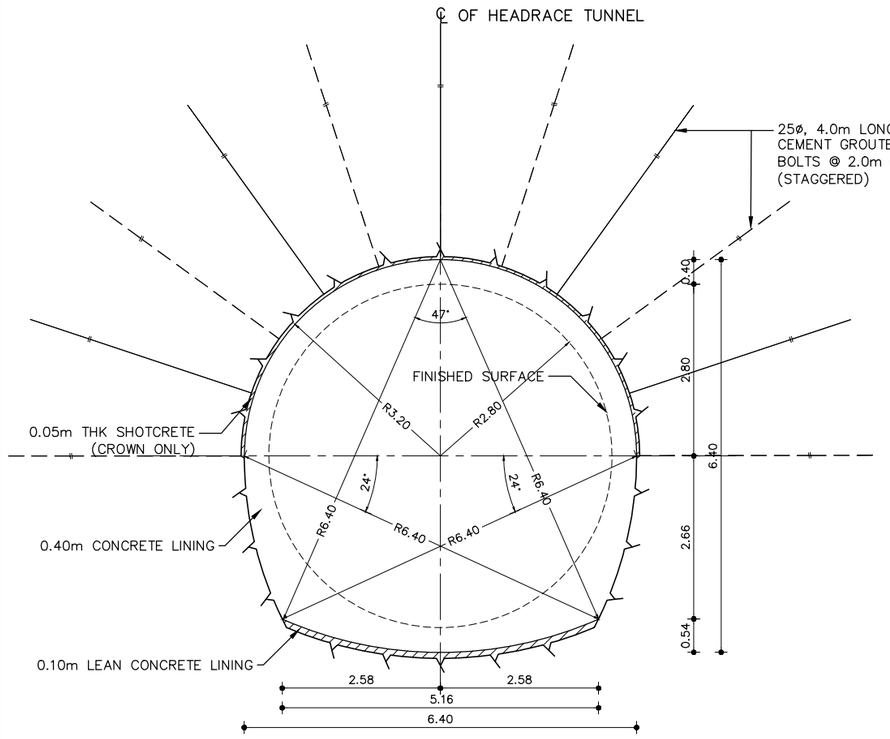
Scale A3: 1:100

DETAILED DESIGN

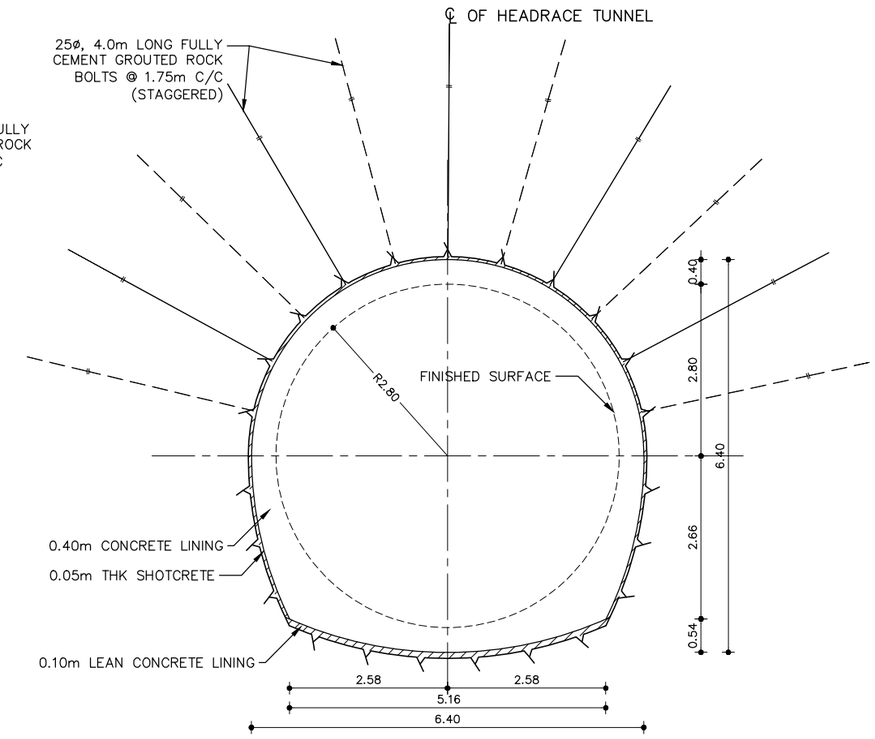
UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL
CONCRETE LINING DETAILS

PROJECT DRAWING

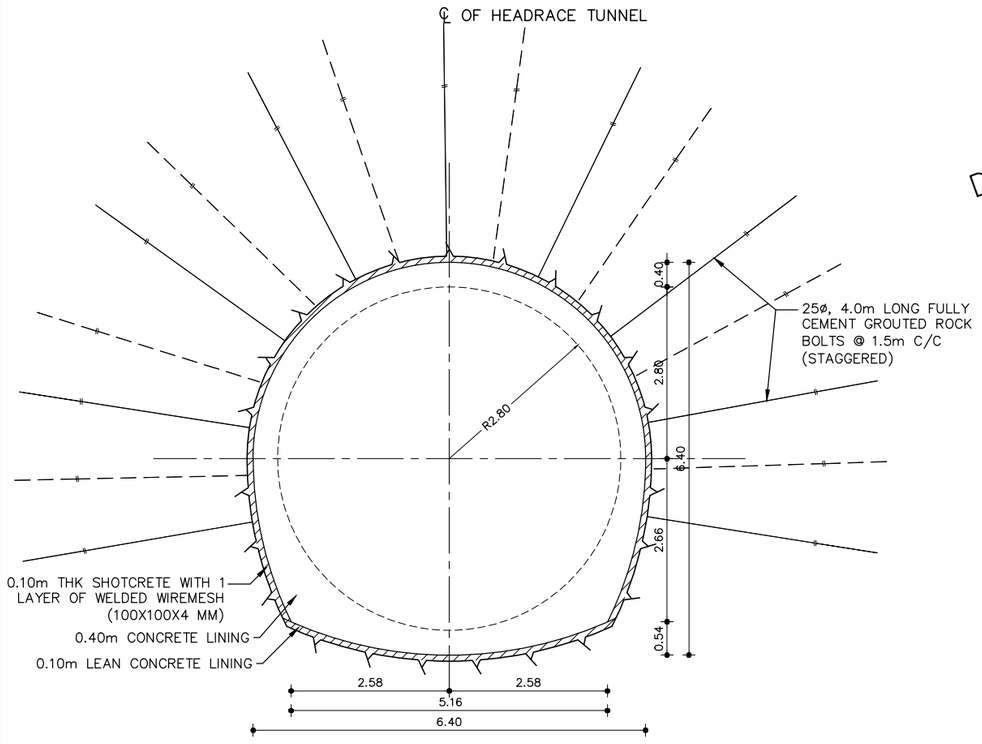
Drwg. No.: 31–00053–DD–4312– Q 1262 REV. –



TYPICAL DETAILS OF SUPPORT SYSTEM
FOR ROCK CLASS II



TYPICAL DETAILS OF SUPPORT SYSTEM
FOR ROCK CLASS III



TYPICAL DETAILS OF SUPPORT SYSTEM
FOR ROCK CLASS IV

DRAFT STATUS:
27.09.2018

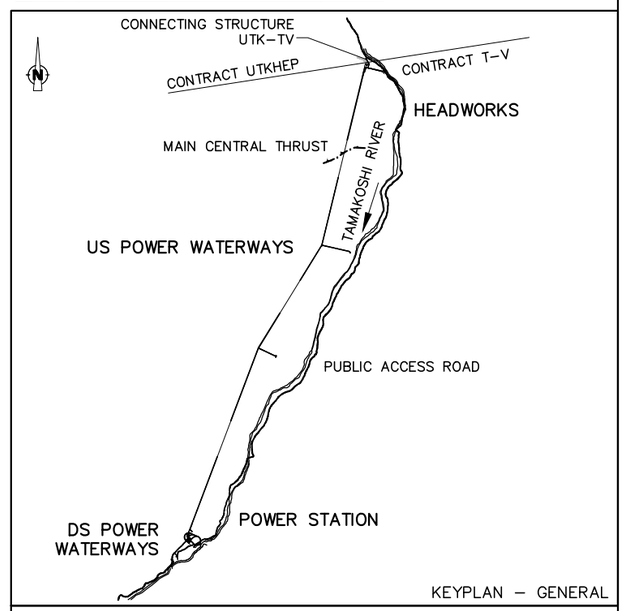
NOTES TO ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 213 KN
2. THE SHOTCERE MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 35MPa.
3. STEEL RIBS SHALL CONFORM TO IS:226–1975.
4. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
5. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
6. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
7. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE ADIT PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
8. IN AREA WITH LARGE WATER INFLOW (SO THAT FULLY GROUTED–BOLT CANNOT BE PLACED) SWELLEX ANCHORS OF CORRESPONDING ARRANGEMENT COULD BE USED INSTEAD OF TEMPORARY SUPPORT UNTIL THE WATER INFLOW IS REDUCED TO A LEVEL THAT ALLOWS SHOTCRETING AND PLACEMENT BY FULLY GROUTED–BOLTS.
9. DRIPPING OR FLOWING WATER HAS TO BE COLLECTED IN PIPES BEFORE SHOTCRETEING SPECIAL DRAIN HOLES MAY BE REQUIRED (USE SWELLEX BOLT).
10. CONDITIONAL FOREPOLING FOR Q–VALUES <0.10, FOREPOLING UMBRELLA SHALL ADOPT AS PER MIN.: ø25 FULLY GROUTED STEEL BARS, 6m EMBEDDED, 2.0m OVERLAP, 300mm SPACING, 10° ANGLE

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT

SCALE 1:100
–1 0 1 2 3 4 5 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31–00053–DD–4312–Q–1260	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT
31–00053–DD–4312–Q–1261	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LONGITUDINAL SECTION

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	27.09.18
Drawn	A. K. Basu	27.09.18
Checked	Roloff	27.09.18
Approved	Dr. Moeller	27.09.18

Replaces Drwg. No:

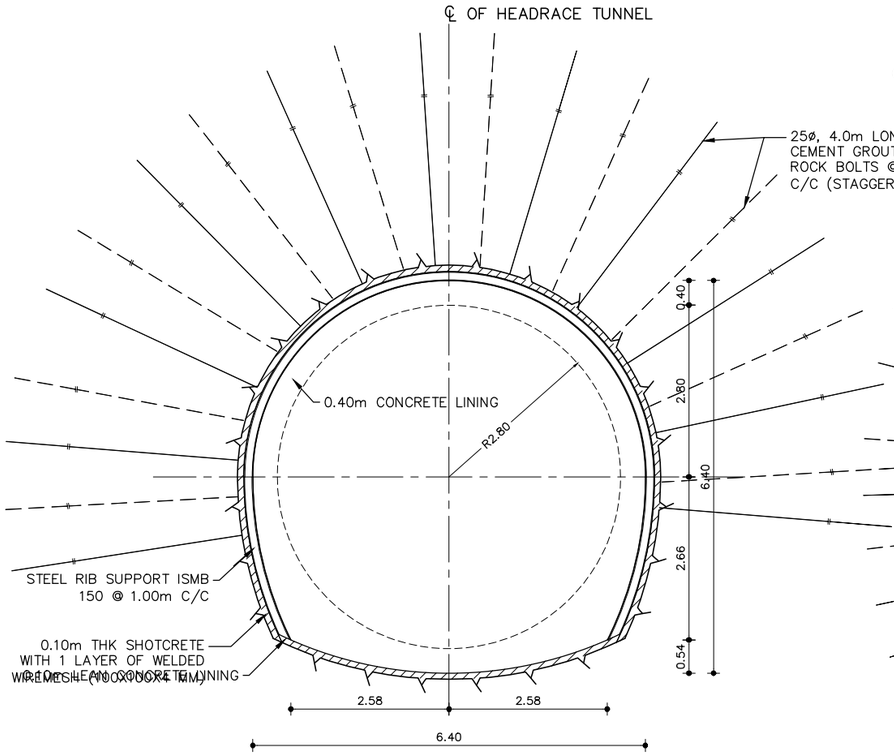
CAD– File No.:

Scale A3: 1:100

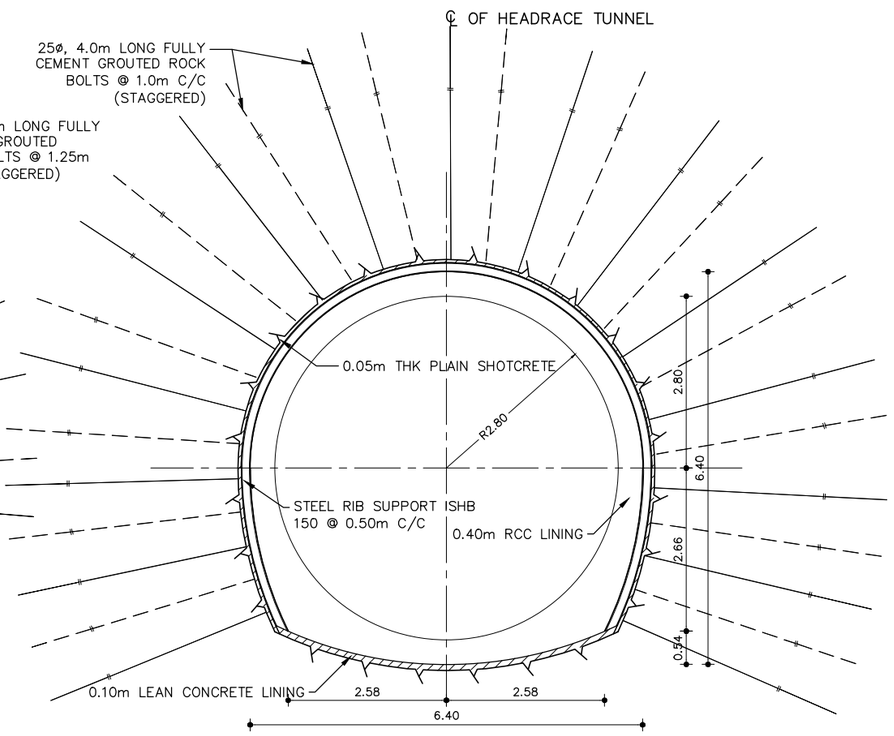
DETAILED DESIGN

UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL
EXCAVATION AND ROCK SUPPORT (SHEET 1 OF 2)
PROJECT DRAWING

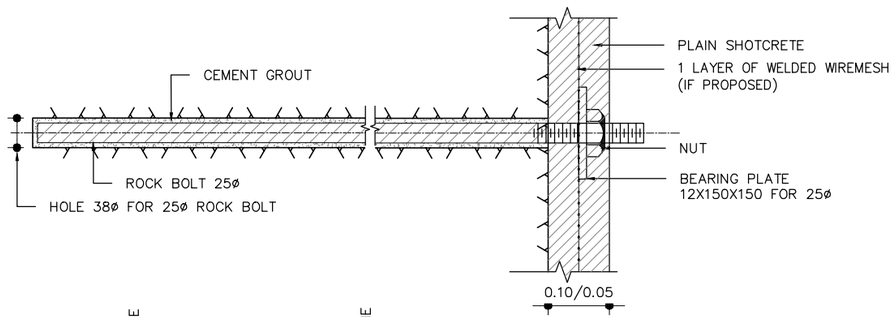
Drwg. No.: 31–00053–DD–4312– S 1265 REV. –



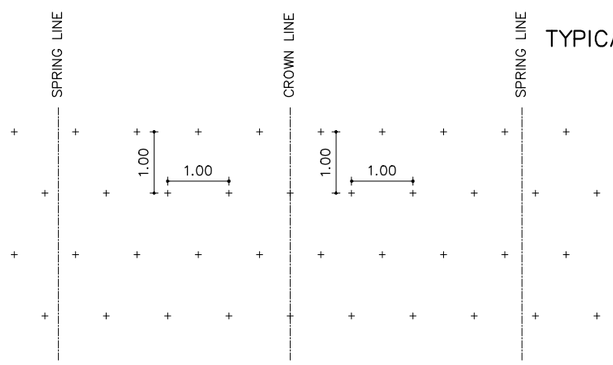
TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS V



TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS VI



TYPICAL ROCK BOLT AND SHOTCRERE DETAILS
NOT TO SCALE



TYPICAL DETAILS OF ROCK BOLTS IN CROWN FOR ROCK CLASS VI
(DEVELOPED VIEW)
NOT TO SCALE

DRAFT STATUS: 27.09.2018

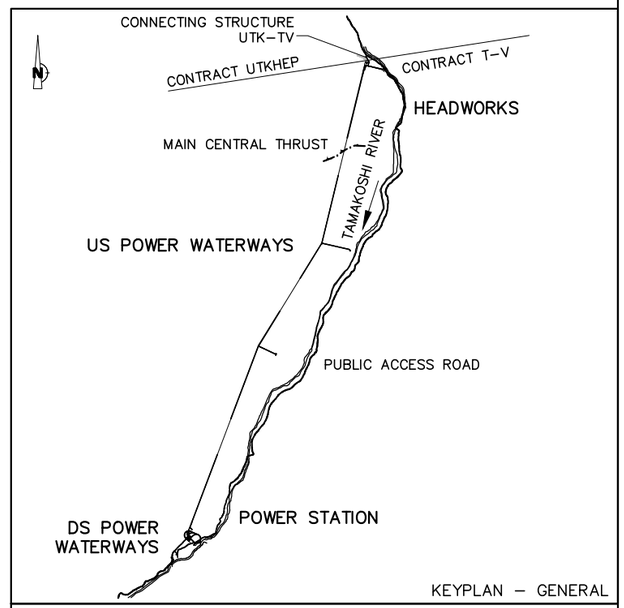
NOTES TO ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 213 KN
2. THE SHOTCERE MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 35MPa.
3. STEEL RIBS SHALL CONFORM TO IS: 226–1975.
4. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
5. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
6. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
7. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE ADIT PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
8. IN AREA WITH LARGE WATER INFLOW (SO THAT FULLY GROUTED–BOLT CANNOT BE PLACED) SWELLEX ANCHORS OF CORRESPONDING ARRANGEMENT COULD BE USED INSTEAD OF TEMPORARY SUPPORT UNTIL THE WATER INFLOW IS REDUCED TO A LEVEL THAT ALLOWS SHOTCRETING AND PLACEMENT BY FULLY GROUTED–BOLTS.
9. DRIPPING OR FLOWING WATER HAS TO BE COLLECTED IN PIPES BEFORE SHOTCRETEING SPECIAL DRAIN HOLES MAY BE REQUIRED (USE SWELLEX BOLT).
10. CONDITIONAL FOREPOLING FOR Q–VALUES <0.10, FOREPOLING UMBRELLA SHALL ADOPT AS PER MIN.: ø25 FULLY GROUTED STEEL BARS, 6m EMBEDDED, 2.0m OVERLAP, 300mm SPACING, 10° ANGLE

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT

SCALE 1:100
–1 0 1 2 3 4 5 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31–00053–DD–4312–Q–1260	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT
31–00053–DD–4312–Q–1261	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LONGITUDINAL SECTION

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	27.09.18
Drawn	A. K. Basu	27.09.18
Checked	Roloff	27.09.18
Approved	Dr. Moeller	27.09.18

Replaces Drwg. No: 31–00053–DD–4364–Y–0000_–

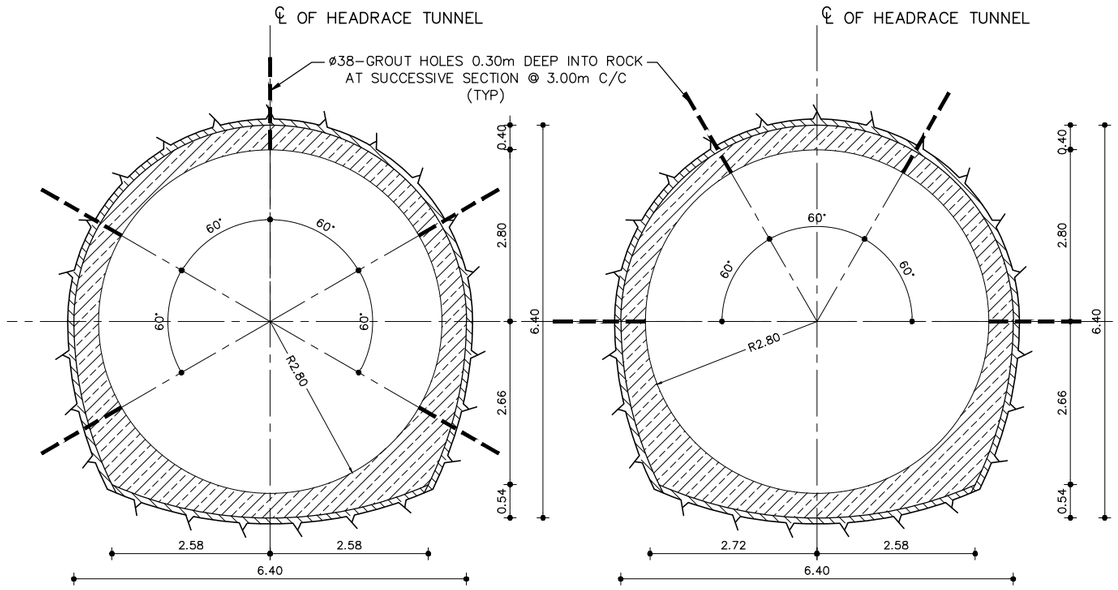
CAD– File No.:

Scale A3: 1:100

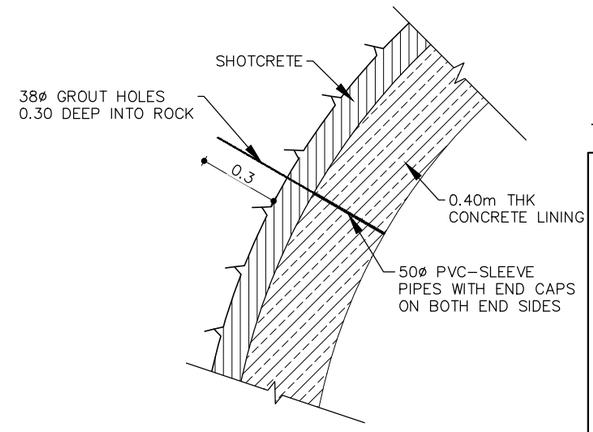
DETAILED DESIGN

UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL
EXCAVATION AND ROCK SUPPORT (SHEET 2 OF 2)
PROJECT DRAWING

Drwg. No.: 31–00053–DD–4312– S 1265 REV. –

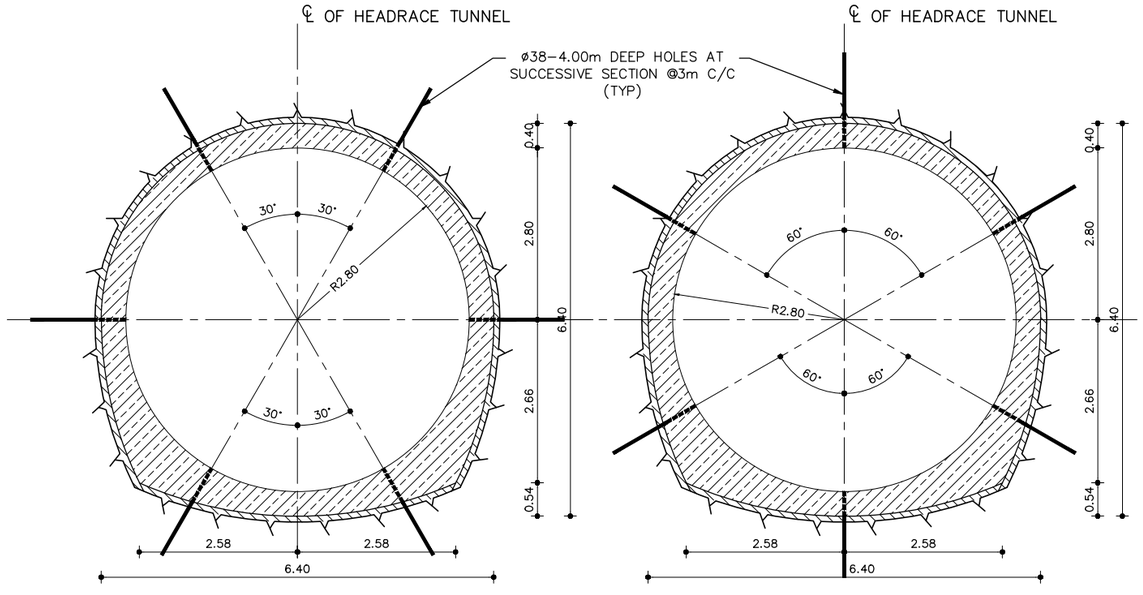


ALTERNATE SECTIONS 3.00m APART
CONTACT GROUTING

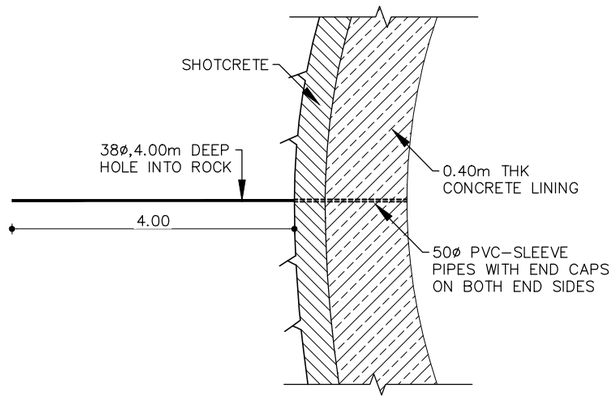


TYPICAL DETAILS OF
CONTACT GROUTING
NOT TO SCALE

DRAFT STATUS:
27.09.2018



ALTERNATE SECTIONS 3.00m APART
CONSOLIDATION GROUTING



TYPICAL DETAILS OF
CONSOLIDATION GROUTING
NOT TO SCALE

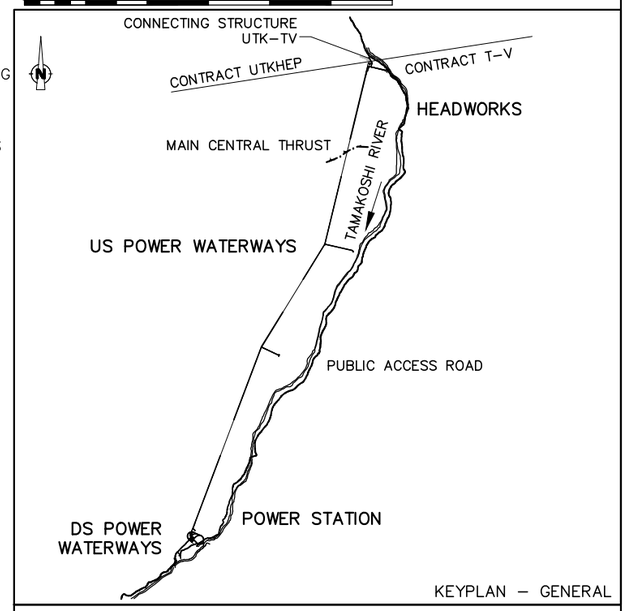
NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING. ONLY WRITTEN DIMENSION SHALL BE FOLLOWED.
3. THIS DRAWING REFERS ONLY TO GROUTING DETAILS IN HEADRACE TUNNEL.
4. CONCRETE FOR LINING SHALL BE M30 (C25/30) GRADE CONFORMING TO IS: 456–2000.
5. GROUT PRESSURE FOR CONTACT GROUTING WILL BE ABOUT 2.5kg/cm^2.
6. GROUT PRESSURE FOR CONSOLIDATION GROUTING WILL BE ABOUT 5.0kg/cm^2.

LEGEND:

CONCRETE CLASS C1 – CONCRETE C25/30
CONCRETE CLASS F – BLINDING CONCRETE C12/15

SCALE 1:100
–1 0 1 2 3 4 5 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31–00053–DD–4312–Q–1260	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT
31–00053–DD–4312–Q–1261	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LONGITUDINAL SECTION

Revisions	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	27.09.18
Drawn	A. K. Basu	27.09.18
Checked	Roloff	27.09.18
Approved	Dr. Moeller	27.09.18

Replaces Drwg. No:
31–00053–DD–4364–Y–0000_–

CAD– File No.:

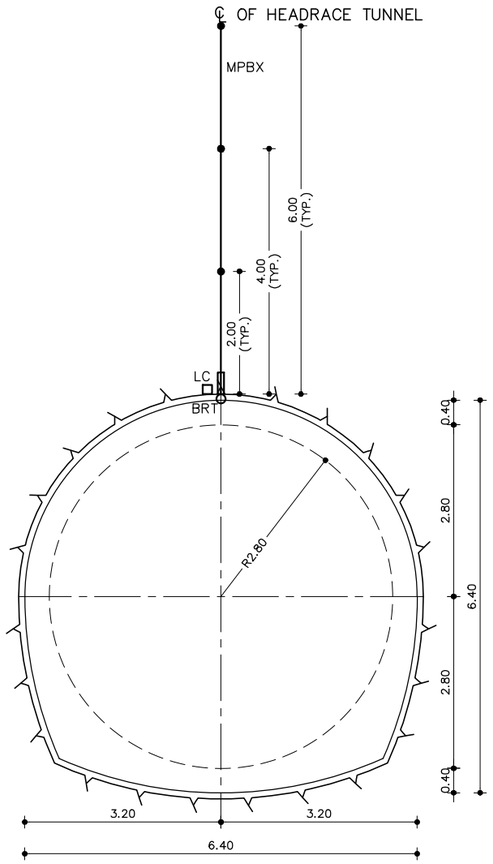
Scale A3: 1:100

DETAILED DESIGN

UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL
GROUTING DETAILS

PROJECT DRAWING

Drwg. No.: 31–00053–DD–4312– Q 1267 REV. –



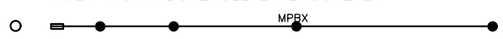
SECTION B–B

1 POINT ROOF SETTLEMENT POINT (TYP.)
(FOR ROOF SETTLEMENT MEASUREMENT)
AT EVERY 25.0M INTERVAL OF TUNNEL LENGTH

SCALE 1:100

LEGEND:

MULTI–POINT BOREHOLE EXTENSOMETER

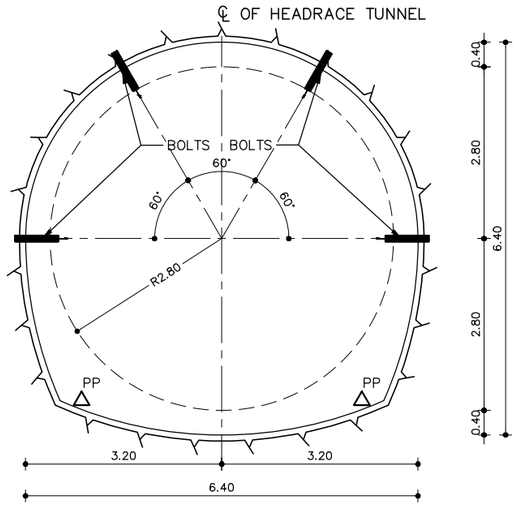


ANCHOR LOAD CELL

LC

BRT (BI–REFLEX–TARGET)

BOLTS



SECTION A–A

5 POINT CONVERGENCE ARRAY (TYP.)
(FOR CONVERGENCE MEASUREMENT)
AT EVERY 50.0M INTERVAL OF TUNNEL LENGTH

SCALE 1:100

NOTES FOR INSTRUMENTATIONS:

DURING EXCAVATION:

CONVERGENCE:

1. CONVERGENCE SECTION SHALL BE PLACED AT SECTIONS WHERE ACC. TO THE ROCK–MASS CLASSIFICATION SYSTEM Q–VALUES ARE LESS THAN 0.3 OR AT AREAS OF CONCERN (WITH HIGH INFLOW ZONES, LONG SECTIONS OF MARGINALLY POOR ROCK MASSES, AT ADJACENT FAULT ZONES, AT INTERSECTION AREAS ETC.);
2. DISTANCE BETWEEN CONVERGENCE SECTION FOR AREAS WITH 0.1<Q–VALUE<0.3 SHALL BE LIMITED TO 15M, AT AREAS WITH Q–VALUE<0.1 DISTANCE TO 6M;
3. ADDITIONAL CONVERGENCE SECTION MAY ADD ON THE DISCRETION OF THE ENGINEER;
4. CONVERGENCE SECTION SHALL CONSIST OF 4 POINTS TRAPEZOIDAL ARRANGED;
5. MEASUREMENT SHALL FOLLOW A FREQUENCY PATTERN SUCH AS
6. –DAILY MEASUREMENTS SHALL BE TAKEN FOR FIRST 20 DAYS OR UNTIL THE EXCAVATION FACE GETS FARTHER THAN 15M FROM THE SECTION;
7. –FOLLOWING WITH WEEKLY MEASUREMENTS OR UNTIL THE EXCAVATION FACE GETS FARTHER THAN 75M FROM THE SECTION. THEREAFTER, MEASUREMENTS SHALL BE EVALUATED AND IN CASE OF NO FLUCTUATION OR CONVERGENCE, MEASUREMENTS MAY ON MONTHLY BASIS.

EXTENSOMETER:

1. SHALL BE INSTALLED AND MAINTAIN AT SECTIONS WITH Q–VALUE <0.3 AND AT AREAS OF POSSIBLE CONCERN OR AS DIRECTED BY THE ENGINEER.
2. MAXIMUM SPACING BETWEEN CONVERGENCE SECTION SHOULD NOT EXCEED 200 M AND MAXIMUM SPACING BETWEEN EXTENSOMETERS SHOULD NOT EXCEED 300 M.

PERMANENT OR AFTER COMPLETION:

1. LOCATION OF PERMANENT MONITORING SECTIONS SHALL BE INSTALLED ONLY AT AREA OF CONCERN (WITH HIGH INFLOW ZONES, LONG SECTIONS OF MARGINALLY POOR ROCK MASSES, AT ADJACENT FAULT ZONES, AT INTERSECTION AREAS ETC.);
2. MONITORING SECTION SHALL CONSIST OF REMOTE MONITORING DEVICES FOR MPBX EXTENSOMETER, LOAD CELL AND IF REQUIRED WIRE PIEZOMETER;
3. CABLE IN SLEEVE PIPES PROVIDED FROM INDIVIDUAL INSTRUMENTS AT DIFFERENT LOCATIONS WILL BE CONNECTED TO SWITCH BOXES FOR OBSERVING DATA AND ROUTED TO READING POINTS WHICH SHALL BE NEARBY AT AN ACCESSIBLE PLACE.

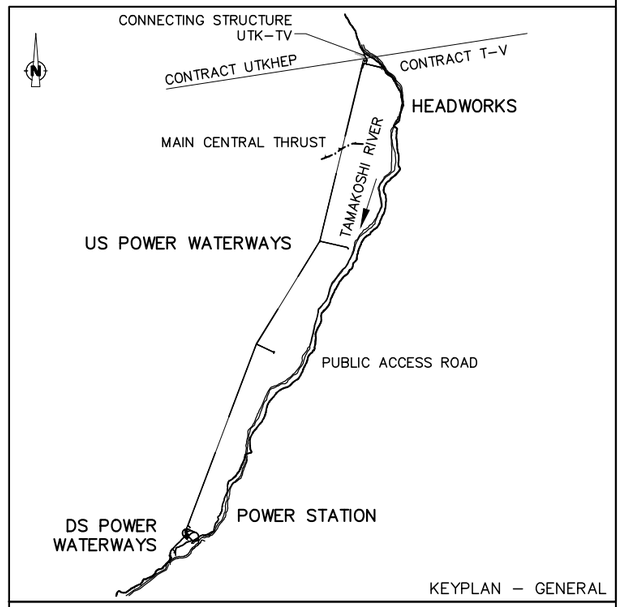
NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].

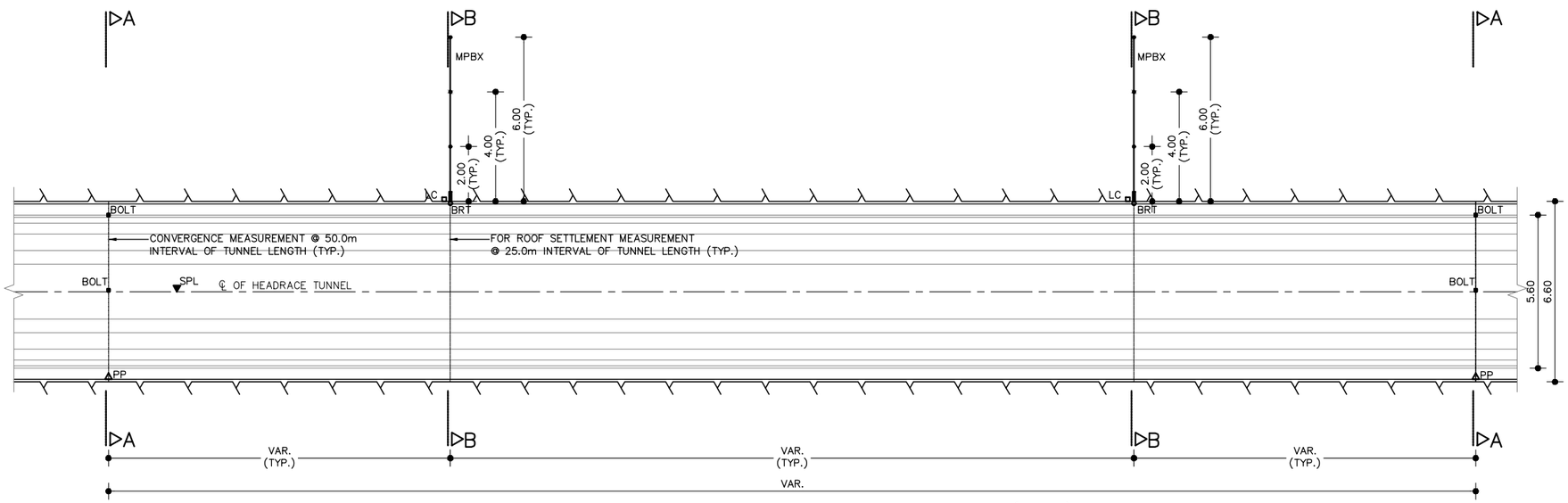
DRAFT STATUS:
04.10.2018

SCALE 1:100
–1 0 1 2 3 4 5 [m]

SCALE 1:200
–2 0 2 4 6 8 10 [m]



KEYPLAN – GENERAL



HEADRACE TUNNEL L–SECTION (TYP.)

SCALE 1:200

Reference Drawings

Drwg. No.	Title
31–00053–DD–4312–Q–1260	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LAYOUT
31–00053–DD–4312–Q–1261	UPSTREAM POWER WATERWAYS, HEADRACE TUNNEL, LONGITUDINAL SECTION

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	04.10.18
Drawn	A. K. Basu	04.10.18
Checked	Roloff	04.10.18
Approved	Dr. Moeller	04.10.18

Replaces Drwg. No:

CAD– File No.:

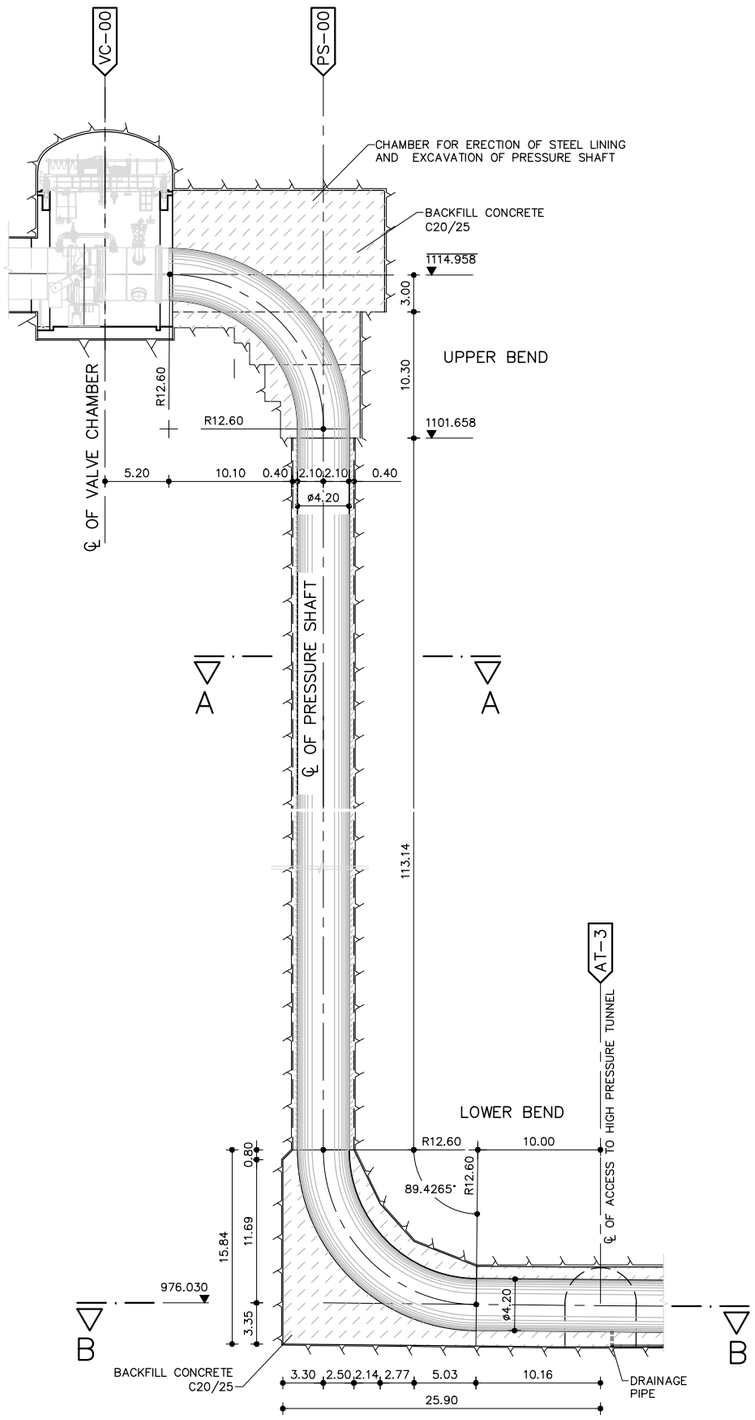
Scale A3: 1:100

DETAILED DESIGN

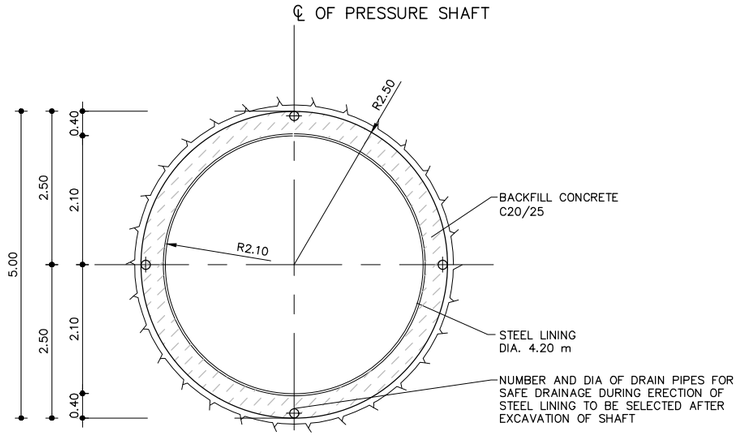
UPSTREAM POWER WATERWAYS
HEADRACE TUNNEL
INSTRUMENTATION DETAILS

PROJECT DRAWING

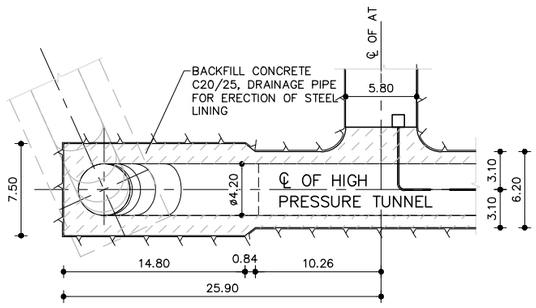
Drwg. No.: 31–00053–DD–4312– S 1268 | REV. | –



LONGITUDINAL SECTION
THROUGH ℄ OF DISCHARGE SYSTEM
SCALE 1:500



SECTION A–A
PRESSURE SHAFT
SCALE 1:100



SECTION B–B
PLAN LOWER BEND
SCALE 1:500

DRAFT STATUS:
08.11.2018

NOTES:
1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO–ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).

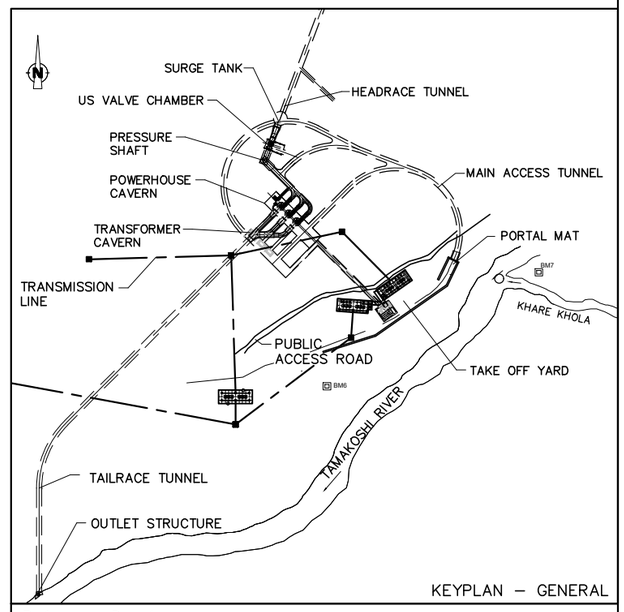
LEGEND:
CONCRETE CLASS A – BACKFILL CONCRETE C20/25

UNFINISHED TOP OF SLAB

FINISHED FLOOR LEVEL

SCALE 1:500
−5 0 5 10 15 20 25 [m]

SCALE 1:100
−1 0 1 2 3 4 5 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31–00053–DD–4300–N–1014	GENERAL PROJECT INFORMATION, DOWNSTREAM POWER WATERWAYS

Revisions		Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	31.07.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No:
31–00053–DD–4331–Y–0000_–

CAD– File No.:

DETAILED DESIGN

UPSTREAM POWER WATERWAYS

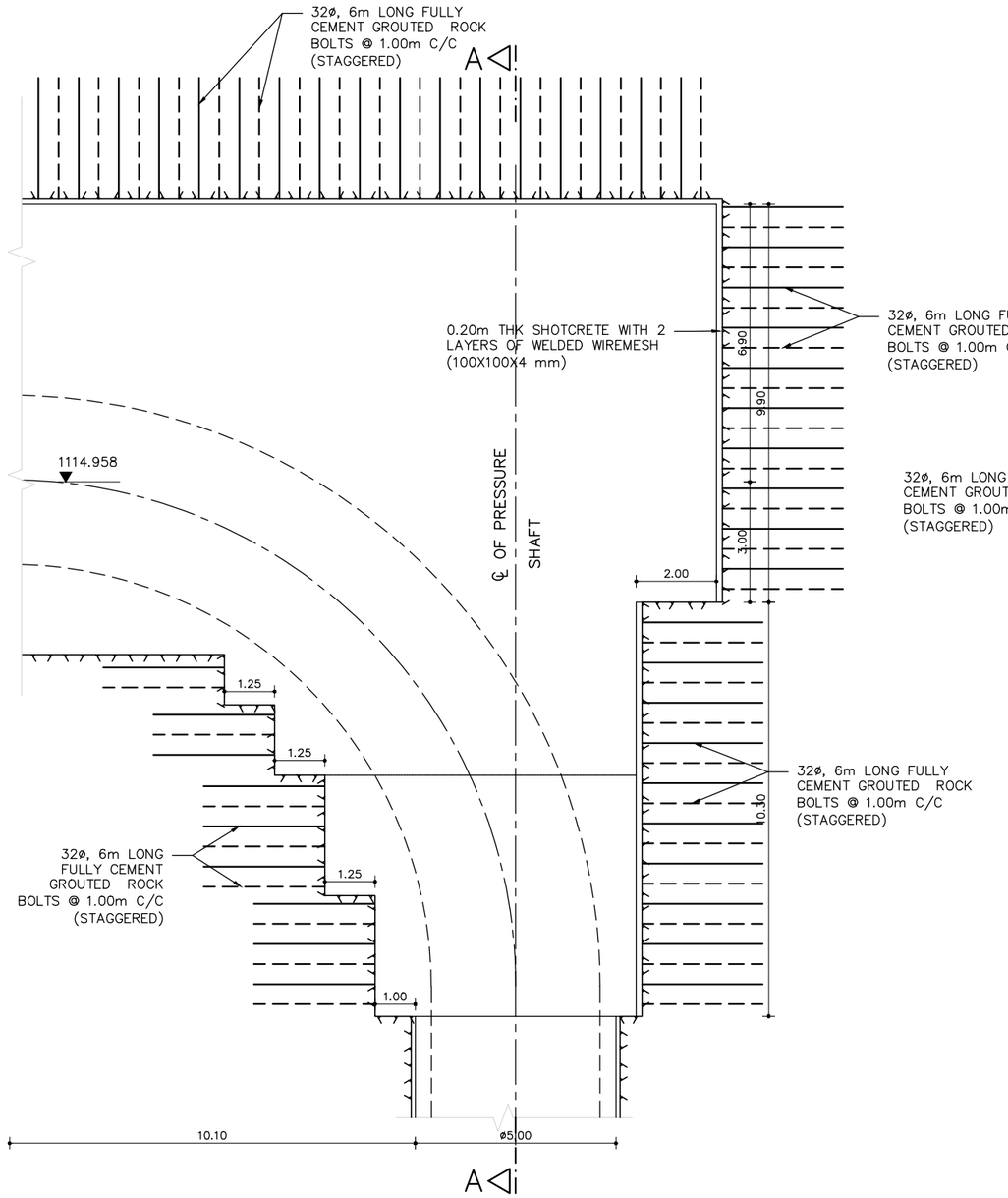
PRESSURE SHAFT

SECTIONS

PROJECT DRAWING

Scale A3: 1:500, 1:100

Drwg. No.: 31–00053–DD–4331– Q 1290 REV. –



SECTION B–B
UPPER BEND OF PRESSURE SHAFT
SCALE 1:150

SECTION A–A
UPPER BEND OF PRESSURE SHAFT
SCALE 1:150

NOTES TO ROCK SUPPORT:

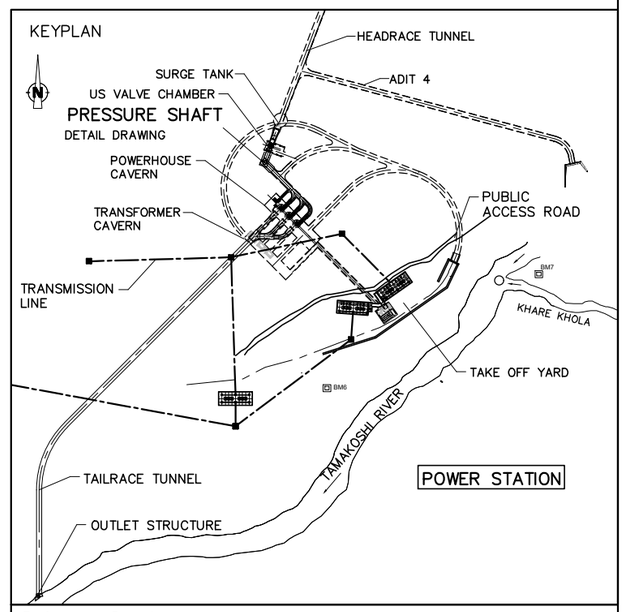
1. FULLY CEMENT GROUTED ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 32 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 349 KN
2. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
3. 10 NOS. PRESTRESSED ROCK ANCHORS WITH A LENGTH OF 20 M AND A WORKING LOAD OF 1,000 KN HAVE TO BE AVAILABLE ON SITE FOR UNEXPECTED GEOTECHNICAL CONDITIONS.
4. INTERSECTING TUNNELS ON THE LAST 12M BEFORE ENTERING THE CHAMBER SHALL BE SUPPORTED 1 RS HIGHER THAN WOULD BE APPLICABLE ACCORDING TO THE GEOLOGY.
5. ROCKSUPPORT ON THE PERIPHERY OF INTERSECTING TUNNEL DEPENDS ON SEQUENCE OF EXCAVATION AND SHALL BE MODIFIED BY THE ENGINEER AT SITE PRIOR APPLYING.

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT.

DRAFT STATUS:
14.10.2018

SCALE 1:150
−1.5 0 1.5 3 4.5 6 7.5 [m]



Reference Drawings

Drwg. No.	Title
31–00053–DD–4331–Q1290	UPSTREAM POWER WATERWAYS– PRESSURE SHAFT–SECTION

Revisions	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	21.09.18
Drawn	A. K. Basu	21.09.18
Checked	Roloff	21.09.18
Approved	Dr. Moeller	21.09.18

Replaces Drwg. No:

CAD– File No.:

Scale A3: 1:150

DETAILED DESIGN

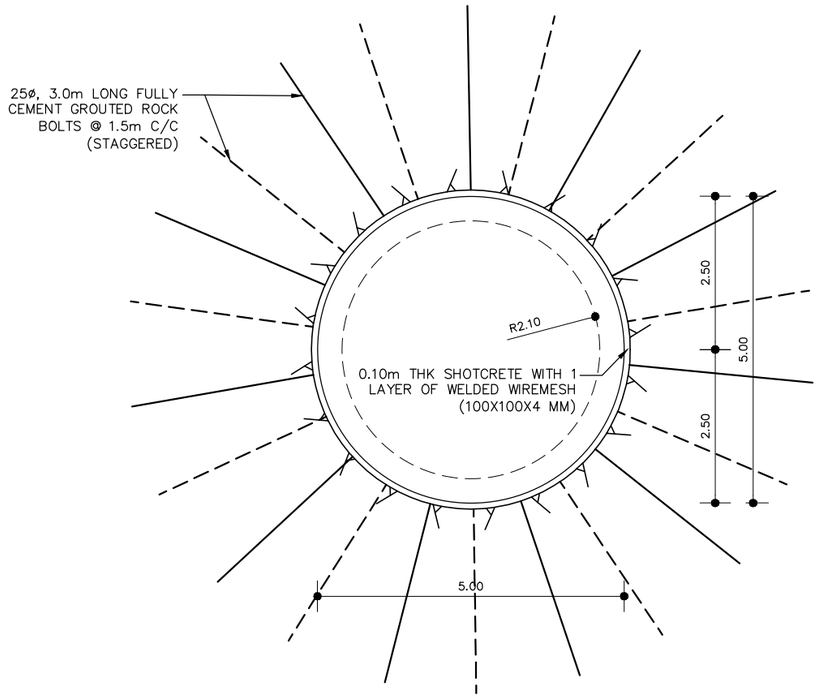
UPSTREAM POWER WATERWAYS

UPPER BEND OF PRESSURE SHAFT

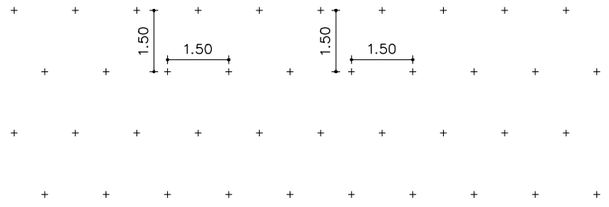
EXCAVATION AND ROCK SUPPORT

PROJECT DRAWING

Drwg. No.: 31–00053–DD–4331– S 1292 REV. –



PRESSURE SHAFT (VERTICAL)
TYPICAL DETAILS OF SUPPORT SYSTEM



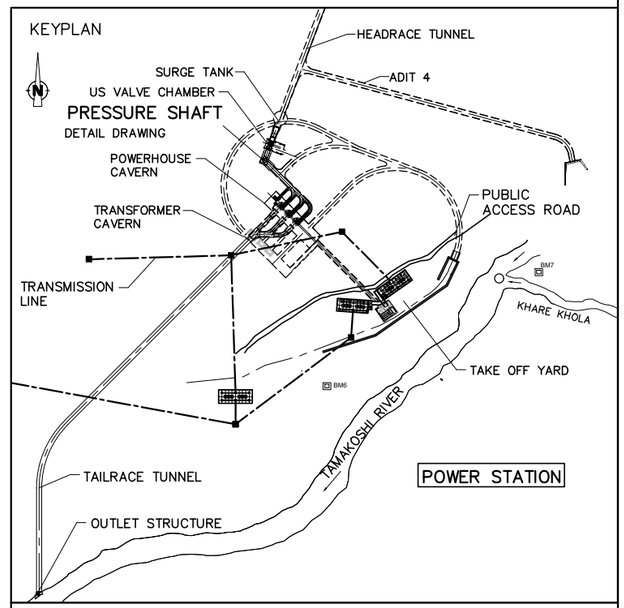
TYPICAL DETAILS OF ROCK BOLTS OF PRESSURE SHAFT
(DEVELOPED VIEW)
NOT TO SCALE

DRAFT STATUS:
14.10.2018

NOTES:

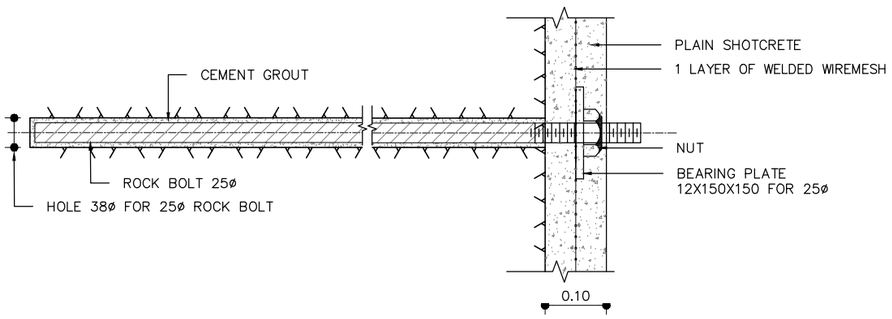
1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT.

SCALE 1:100
−1 0 1 2 3 4 5 [m]



NOTES TO ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 213 KN
2. THE SHOTCERE MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 35MPa.
3. STEEL RIBS SHALL CONFORM TO IS: 226–1975.
4. AN ADDITIONAL LAYER OF 50MM THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE ADIT PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREA WITH LARGE WATER INFLOW (SO THAT FULLY GROUTED–BOLT CANNOT BE PLACED) SWELLEX ANCHORS OF CORRESPONDING ARRANGEMENT COULD BE USED INSTEAD OF TEMPORARY SUPPORT UNTIL THE WATER INFLOW IS REDUCED TO A LEVEL THAT ALLOWS SHOTCRETING AND PLACEMENT BY FULLY GROUTED–BOLTS.
10. DRIPPING OR FLOWING WATER HAS TO BE COLLECTED IN PIPES BEFORE SHOTCRETEING SPECIAL DRAIN HOLES MAY BE REQUIRED (USE SWELLEX BOLT).
11. CONDITIONAL FOREPOLING FOR Q–VALUES <0.10, FOREPOLING UMBRELLA SHALL ADOPT AS PER MIN.: ø25 FULLY GROUTED STEEL BARS, 6m EMBEDDED, 2.0m OVERLAP, 300mm SPACING, 10° ANGLE



TYPICAL ROCK BOLT AND SHOTCRETE DETAILS
NOT TO SCALE

Reference Drawings

Drwg. No.	Title
31–00053–DD–4331–Q1290	UPSTREAM POWER WATERWAYS– PRESSURE SHAFT–SECTION
31–00053–DD–4330–Q1300	UPSTREAM POWER WATERWAYS– STEEL LINED HIGH PRESSURE TUNNEL–LAYOUT

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	21.09.18
Drawn	A. K. Basu	21.09.18
Checked	Roloff	21.09.18
Approved	Dr. Moeller	21.09.18

Replaces Drwg. No:

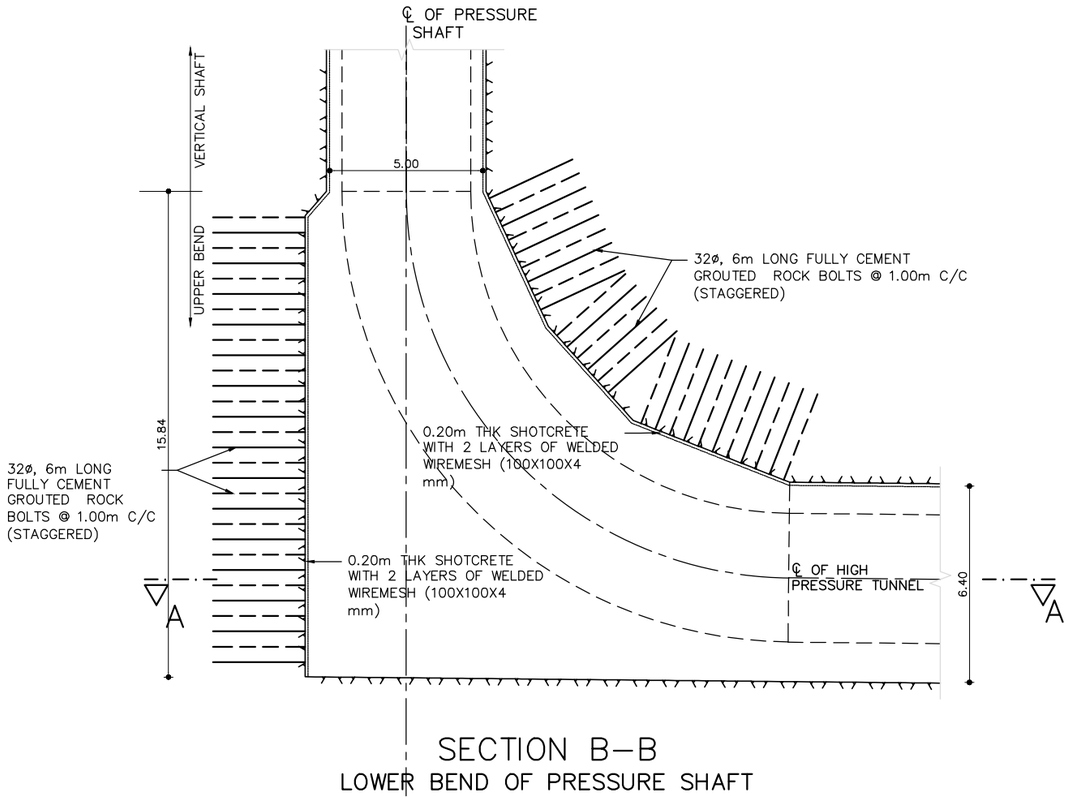
CAD– File No.:

Scale A3: 1:100

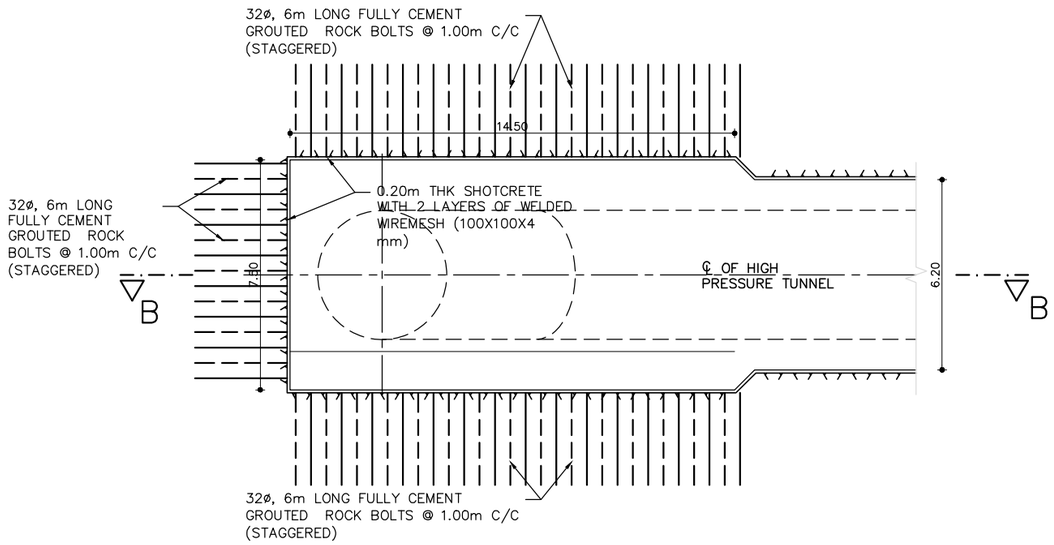
DETAILED DESIGN

UPSTREAM POWER WATERWAYS
PRESSURE SHAFT
EXCAVATION AND ROCK SUPPORT
PROJECT DRAWING

Drwg. No.: 31–00053–DD–4331– S 1293 REV. –



SECTION B–B
LOWER BEND OF PRESSURE SHAFT
SCALE 1:150



SECTION B–B
LOWER BEND OF PRESSURE SHAFT
SCALE 1:150

NOTES TO ROCK SUPPORT:

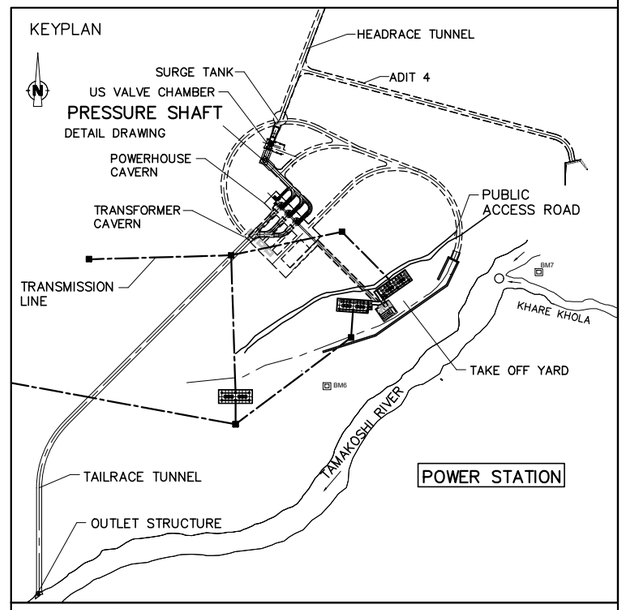
1. FULLY CEMENT GROUTED ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 32 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 349 KN
2. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
3. 10 NOS. PRESTRESSED ROCK ANCHORS WITH A LENGTH OF 20 M AND A WORKING LOAD OF 1,000 KN HAVE TO BE AVAILABLE ON SITE FOR UNEXPECTED GEOTECHNICAL CONDITIONS.
4. INTERSECTING TUNNELS ON THE LAST 12M BEFORE ENTERING THE CHAMBER SHALL BE SUPPORTED 1 RS HIGHER THAN WOULD BE APPLICABLE ACCORDING TO THE GEOLOGY.
5. ROCKSUPPORT ON THE PERIPHERY OF INTERSECTING TUNNEL DEPENDS ON SEQUENCE OF EXCAVATION AND SHALL BE MODIFIED BY THE ENGINEER AT SITE PRIOR APPLYING.

DRAFT STATUS:
14.10.2018

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT.

SCALE 1:100
–1 0 1 2 3 4 5 [m]



Reference Drawings

Drwg. No.	Title
31–00053–DD–4331–Q1290	UPSTREAM POWER WATERWAYS– PRESSURE SHAFT–SECTION
31–00053–DD–4330–Q1300	UPSTREAM POWER WATERWAYS– STEEL LINED HIGH PRESSURE TUNNEL–LAYOUT

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	21.09.18
Drawn	A. K. Basu	21.09.18
Checked	Roloff	21.09.18
Approved	Dr. Moeller	21.09.18

Replaces Drwg. No:

CAD– File No.:

DETAILED DESIGN

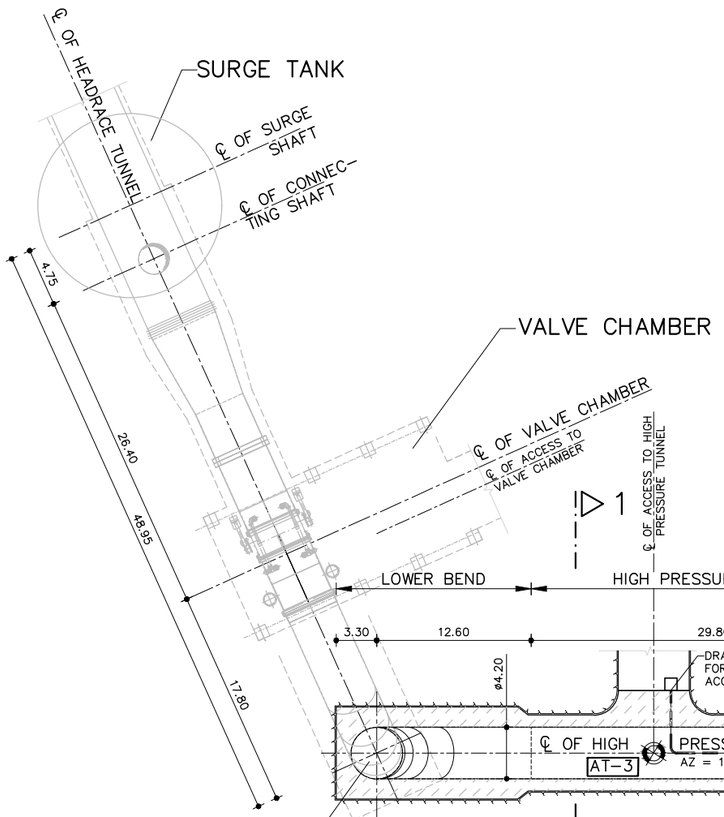
UPSTREAM POWER WATERWAYS

LOWER BEND OF PRESSURE SHAFT

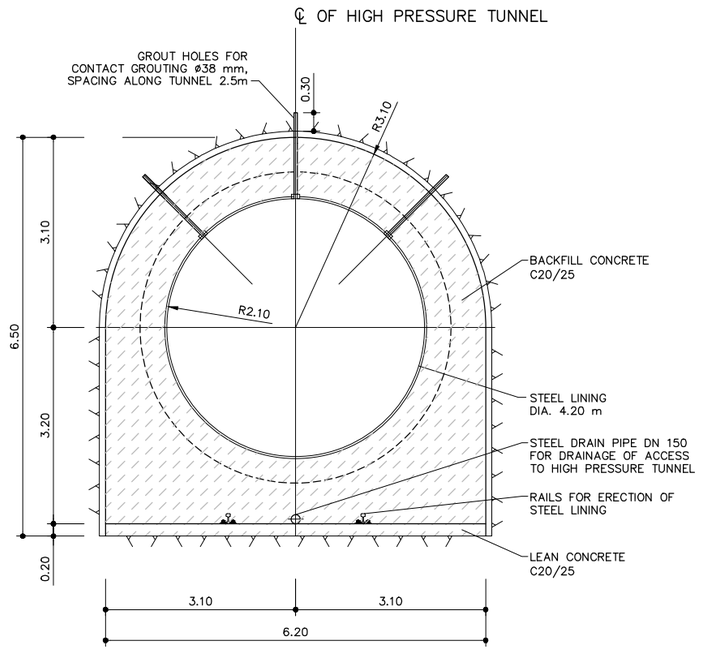
EXCAVATION AND ROCK SUPPORT
PROJECT DRAWING

Scale A3: 1:100

Drwg. No.: 31–00053–DD–4331– S 1294 REV. –



LAYOUT
STEEL LINED HIGH PRESSURE TUNNEL
SCALE 1:500



SECTION 1–1
SCALE 1:100

NOTES:

1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO–ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).

LEGEND:

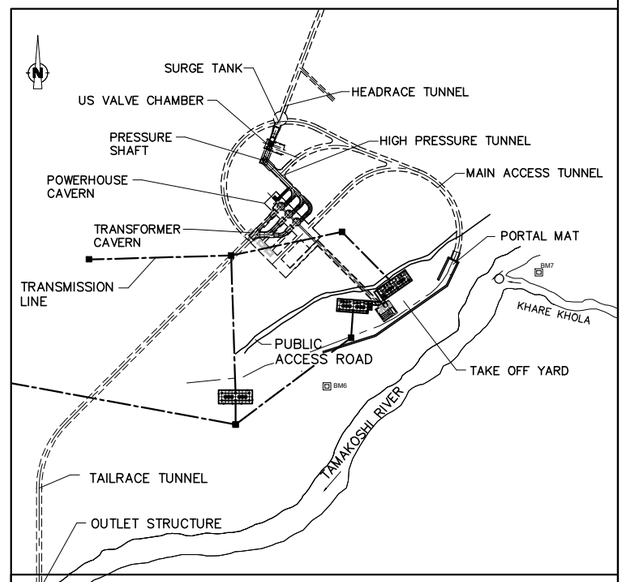
CONCRETE CLASS A – BACKFILL CONCRETE C20/25

UNFINISHED TOP OF SLAB

FINISHED FLOOR LEVEL

SCALE 1:500
–5 0 5 10 15 20 25 [m]

SCALE 1:100
–1 0 1 2 3 4 5 [m]



Reference Drawings — KEYPLAN – GENERAL

Drwg. No.	Title
31–00053–DD–4340–1400	POWER STATION, GENERAL

Revisions		Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	23.10.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No:
...

CAD– File No.:

DETAILED DESIGN

UPSTREAM POWER WATERWAYS

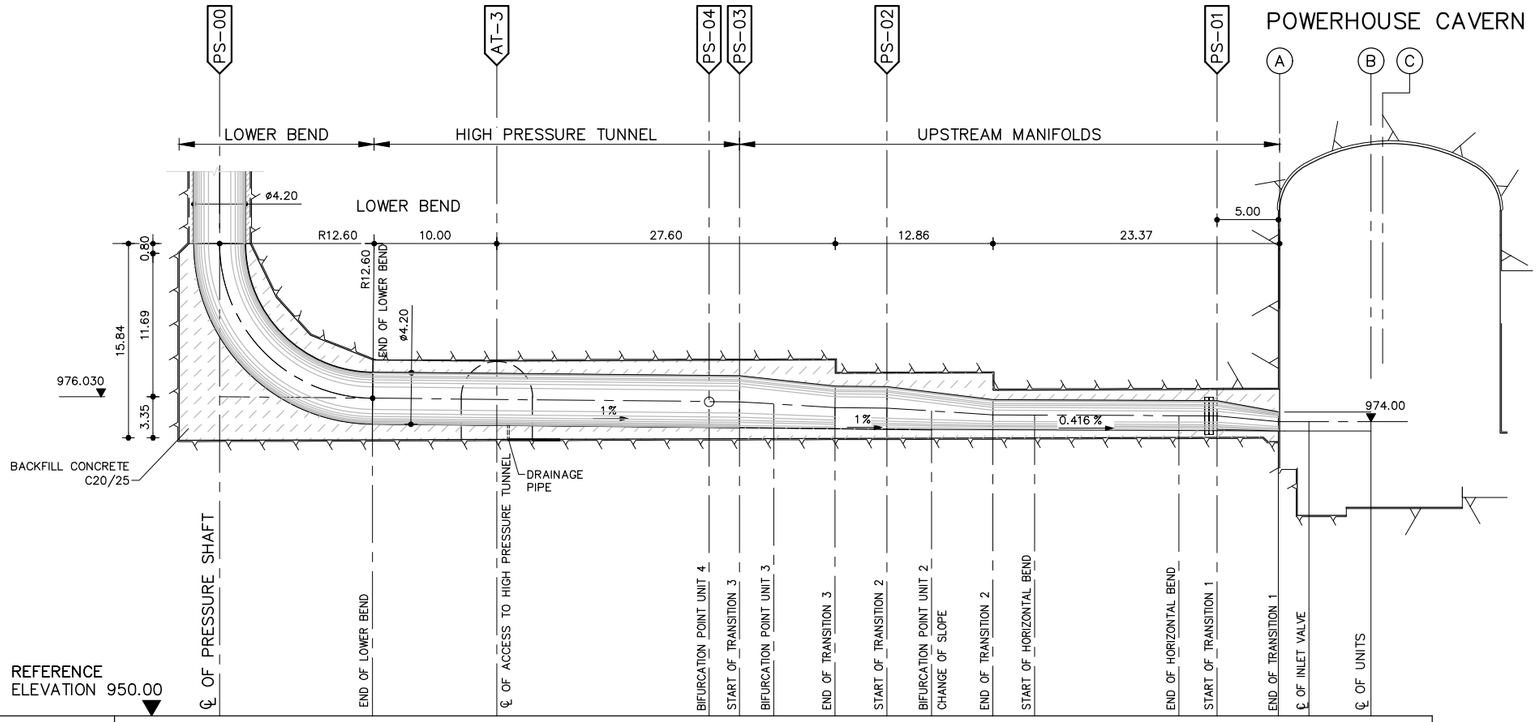
STEEL LINED HIGH PRESSURE TUNNEL

LAYOUT

PROJECT DRAWING

Scale A3: 1:500, 1:100

Drwg. No.: 31–00053–DD–4330–Q 1300 REV. –



POINT DESIGNATION	PS-00		AT-3		PS-04	PS-03		PS-02			PS-01		PH-U1
CHAINAGE [m]	8+142.785	0+000.000	0+010.120		0+027.438	0+029.926	0+032.711	0+037.711	0+041.941	0+045.580	0+050.580	0+053.979	0+065.760	0+068.860	0+073.860	0+076.360	8+253.930
ELEVATION AT CL OF LINING	976.030	975.906	975.804		975.631	975.606	975.441	975.143	975.101	974.865	974.541	974.527	974.478	974.463	974.000	974.000	974.000
VERTICAL ALIGNMENT AT CL		α= 89.4265° R= 12.600m T= 12.475m	S=1.00%				S=5.95%	S=1.00%		S=6.48%		S=0.42%		S=9.27%		S=0.00%	
HORIZONTAL ALIGNMENT		AZ = 135.000000°					AZ = 130.583854°	AZ = 135.000000°		AZ = 129.232037°	AZ = 135.000°	α= 90.0000° R= 7.500m T= 7.500m		AZ = 225.000000°			
PROPERTIES OF TUNNEL LINING	PRESSURE TUNNEL WITH CIRCULAR STEEL LINING						DIA. 4.20/3.43m	DIA. 3.43m		DIA. 3.43/2.425m		DIA. 2.425m		DIA. 2.425/ 1.54m		DIA. 1.540m	

LONGITUDINAL SECTION
THROUGH ℄ OF WATERWAY TO UNIT 1
SCALE 1:500

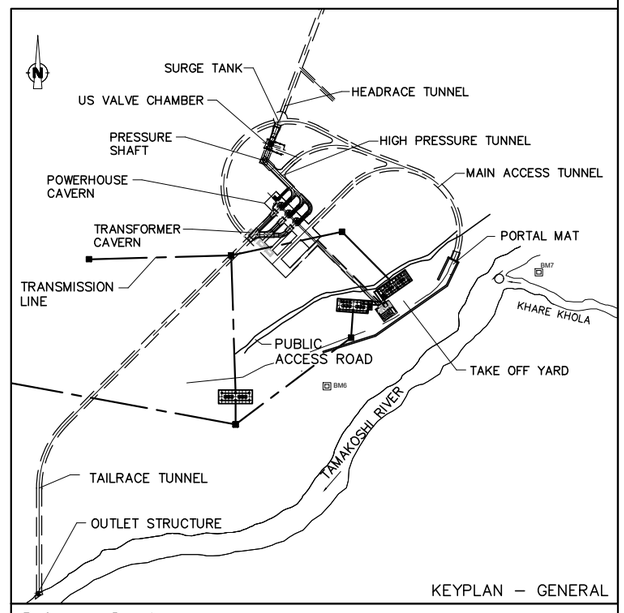
NOTES:
1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO-ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).

LEGEND:
CONCRETE CLASS A – BACKFILL CONCRETE C20/25

UNFINISHED TOP OF SLAB

FINISHED FLOOR LEVEL

SCALE 1:500
−5 0 5 10 15 20 25 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31-00053-DD-4330-Q-1300	UPSTREAM POWER WATERWAYS, STEEL LINED HIGH PRESSURE TUNNEL

Revisions	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	23.10.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No: ...

CAD- File No.:

DETAILED DESIGN

UPSTREAM POWER WATERWAYS

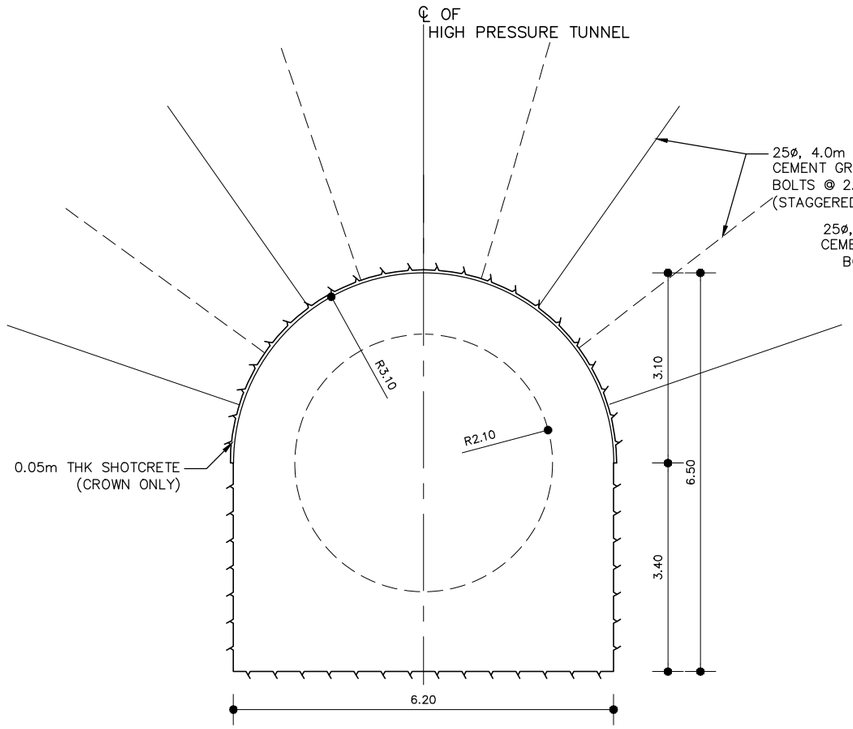
STEEL LINED HIGH PRESSURE TUNNEL

LONGITUDINAL SECTION

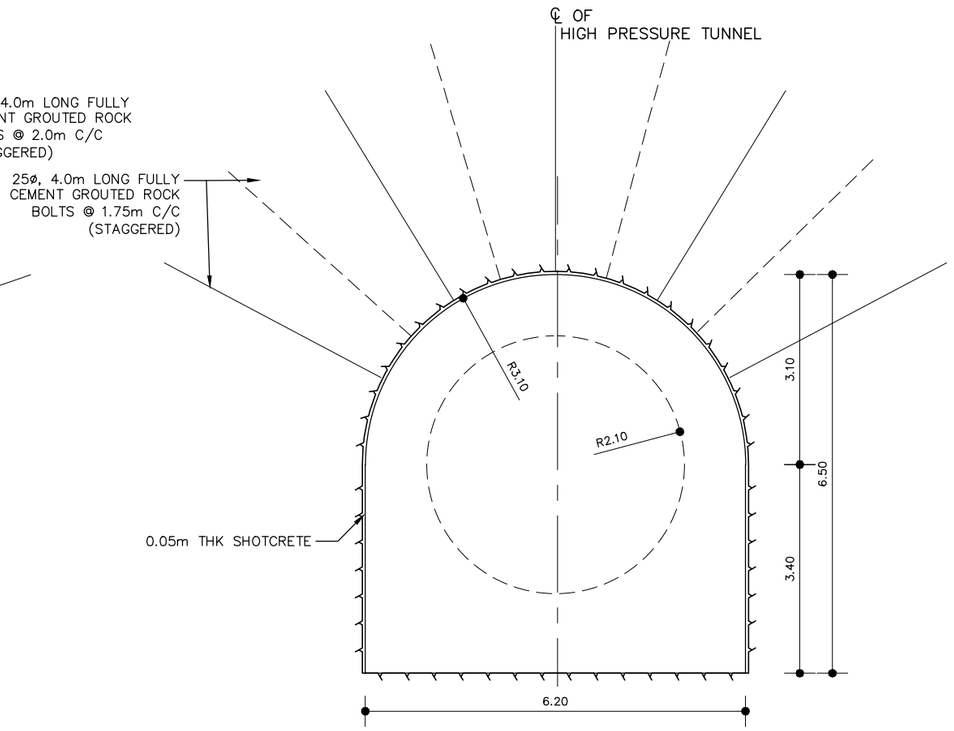
PROJECT DRAWING

Scale A3: 1:500

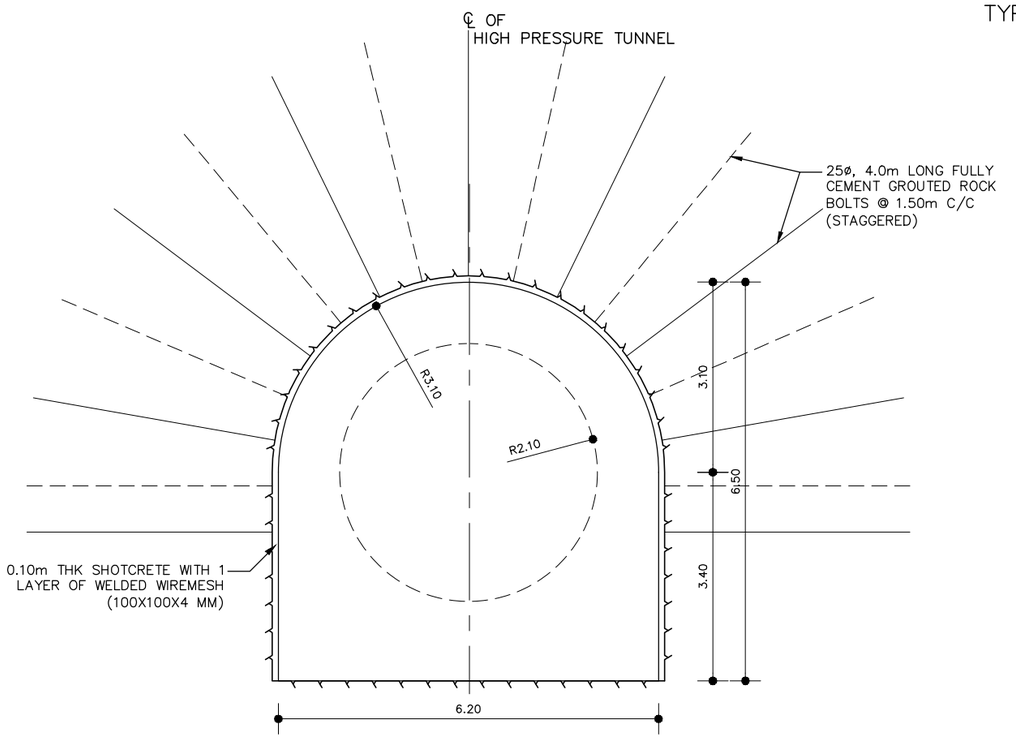
Drwg. No.: 31-00053-DD-4330-Q 1301 REV. –



HIGH PRESSURE TUNNEL (HORIZONTAL)
TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS II



HIGH PRESSURE TUNNEL (HORIZONTAL)
TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS III



HIGH PRESSURE TUNNEL (HORIZONTAL)
TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS IV

NOTES TO ROCK SUPPORT:

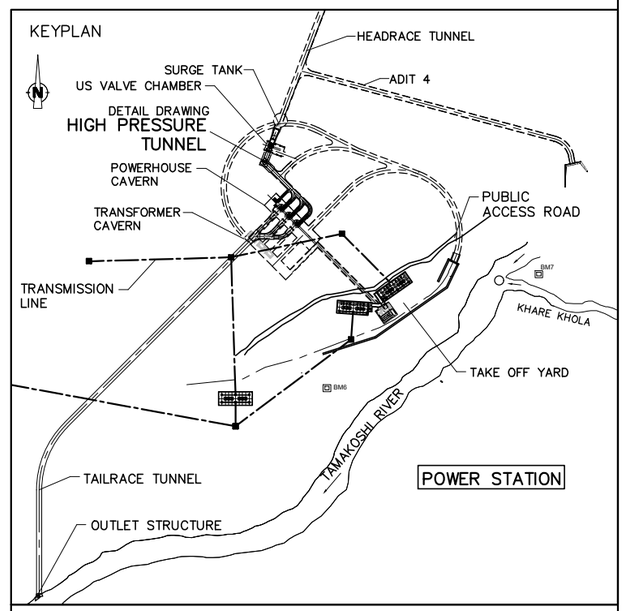
1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 213 KN
2. THE SHOTCERE MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 35MPa.
3. STEEL RIBS SHALL CONFORM TO IS: 226–1975.
4. AN ADDITIONAL LAYER OF 50MM THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE ADIT PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREA WITH LARGE WATER INFLOW (SO THAT FULLY GROUTED–BOLT CANNOT BE PLACED) SWELLEX ANCHORS OF CORRESPONDING ARRANGEMENT COULD BE USED INSTEAD OF TEMPORARY SUPPORT UNTIL THE WATER INFLOW IS REDUCED TO A LEVEL THAT ALLOWS SHOTCRETING AND PLACEMENT BY FULLY GROUTED–BOLTS.
10. DRIPPING OR FLOWING WATER HAS TO BE COLLECTED IN PIPES BEFORE SHOTCRETEING SPECIAL DRAIN HOLES MAY BE REQUIRED (USE SWELLEX BOLT).
11. CONDITIONAL FOREPOLING FOR Q–VALUES <0.10, FOREPOLING UMBRELLA SHALL ADOPT AS PER MIN.: ø25 FULLY GROUTED STEEL BARS, 6m EMBEDDED, 2.0m OVERLAP, 300mm SPACING, 10° ANGLE

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT.

DRAFT STATUS:
12.10.2018

SCALE 1:100
−1 0 1 2 3 4 5 [m]



Reference Drawings

Drwg. No.	Title
31–00053–DD–4330–Q1300	UPSTREAM POWER WATERWAYS– STEEL LINED HIGH PRESSURE TUNNEL–LAYOUT

Revisions		Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	21.09.18
Drawn	A. K. Basu	21.09.18
Checked	Roloff	21.09.18
Approved	Dr. Moeller	21.09.18

Replaces Drwg. No:

CAD– File No.:

DETAILED DESIGN

UPSTREAM POWER WATERWAYS

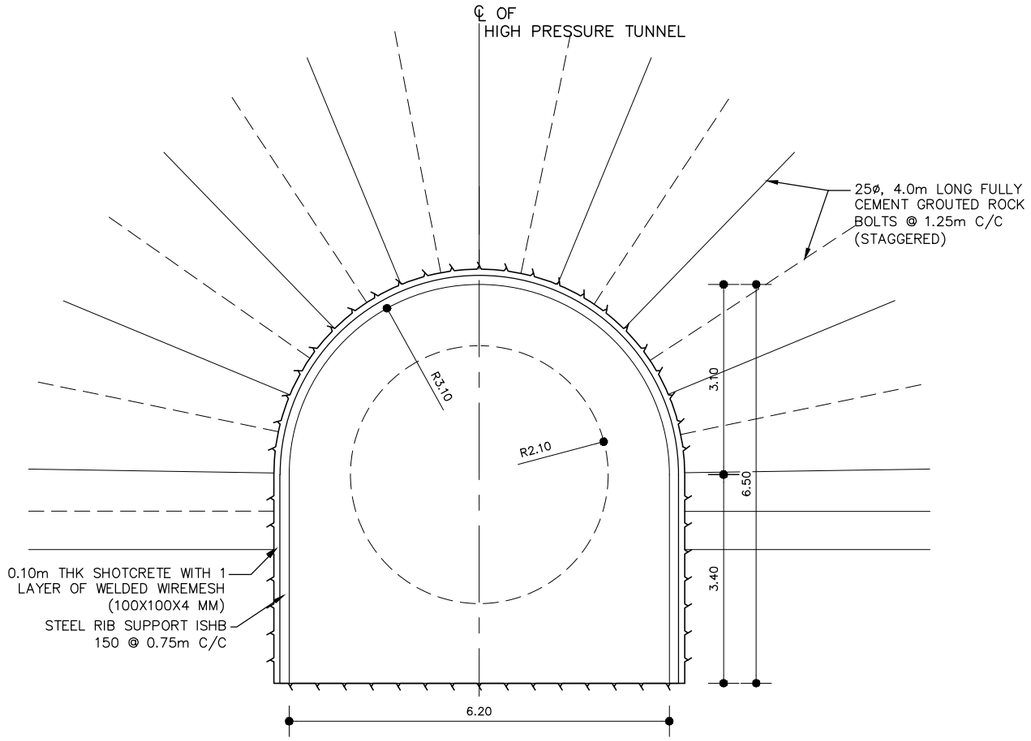
STEEL LINED HIGH PRESSURE TUNNEL

EXCAVATION AND ROCK SUPPORT

PROJECT DRAWING

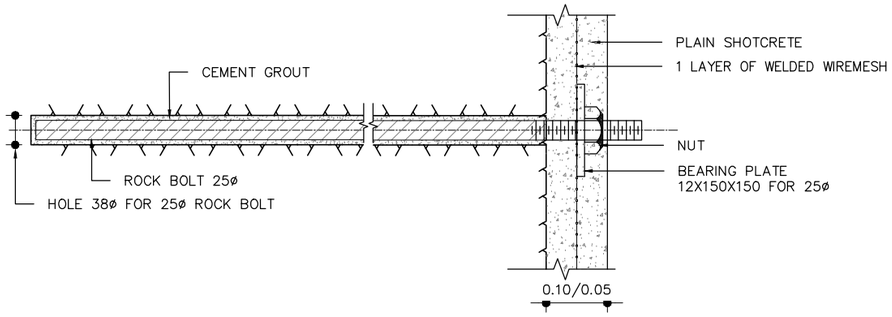
Scale A3: 1:100

Drwg. No.: 31–00053–DD–4330– S 1305 REV. –



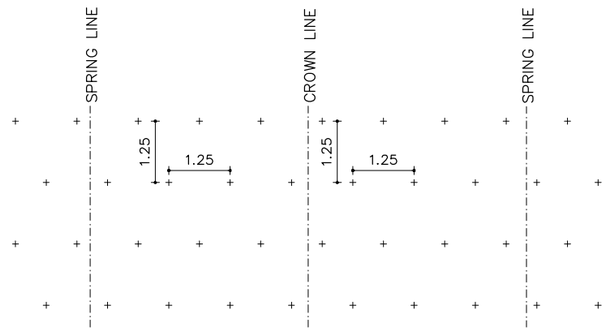
STEEL LINED HIGH PRESSURE TUNNEL (HORIZONTAL)

TYPICAL DETAILS OF SUPPORT SYSTEM FOR ROCK CLASS V



TYPICAL ROCK BOLT AND SHOTCRETE DETAILS

NOT TO SCALE



TYPICAL DETAILS OF ROCK BOLTS OF STEEL LINED I PRESSURE TUNNEL FOR ROCK CLASS V

(DEVELOPED VIEW)

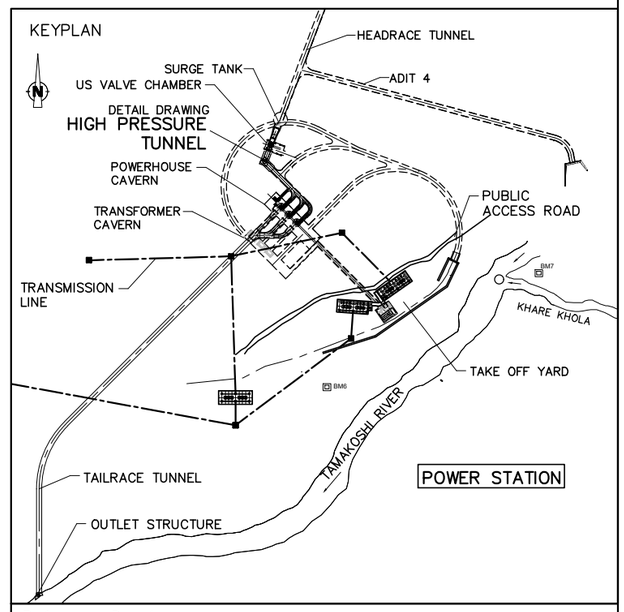
NOTES TO ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 MM
   - YIELD STRENGTH 500 N/MM²
   - MAXIMUM TENSILE CAPACITY 213 KN
2. THE SHOTCERE MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 35MPa.
3. STEEL RIBS SHALL CONFORM TO IS: 226–1975.
4. AN ADDITIONAL LAYER OF 50MM THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE ADIT PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREA WITH LARGE WATER INFLOW (SO THAT FULLY GROUTED–BOLT CANNOT BE PLACED) SWELLEX ANCHORS OF CORRESPONDING ARRANGEMENT COULD BE USED INSTEAD OF TEMPORARY SUPPORT UNTIL THE WATER INFLOW IS REDUCED TO A LEVEL THAT ALLOWS SHOTCRETING AND PLACEMENT BY FULLY GROUTED–BOLTS.
10. DRIPPING OR FLOWING WATER HAS TO BE COLLECTED IN PIPES BEFORE SHOTCRETEING SPECIAL DRAIN HOLES MAY BE REQUIRED (USE SWELLEX BOLT).
11. CONDITIONAL FOREPOLING FOR Q–VALUES <0.10, FOREPOLING UMBRELLA SHALL ADOPT AS PER MIN.: ø25 FULLY GROUTED STEEL BARS, 6m EMBEDDED, 2.0m OVERLAP, 300mm SPACING, 10° ANGLE

NOTES:

1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
4. ALL SHOTCRETE SHALL BE PLAIN SHOTCRETE WITH WIREMESH IF ASSIGNED IT ACCORDING TO ROCK SUPPORT.

SCALE 1:100
−1 0 1 2 3 4 5 [m]



Reference Drawings

Drwg. No.	Title
31–00053–DD–4330–Q1300	UPSTREAM POWER WATERWAYS– STEEL LINED HIGH PRESSURE TUNNEL–LAYOUT

Revisions		Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	R. Shrivastava	21.09.18
Drawn	A. K. Basu	21.09.18
Checked	Roloff	21.09.18
Approved	Dr. Moeller	21.09.18

Replaces Drwg. No:

CAD– File No.:

Scale A3: 1:100

DETAILED DESIGN

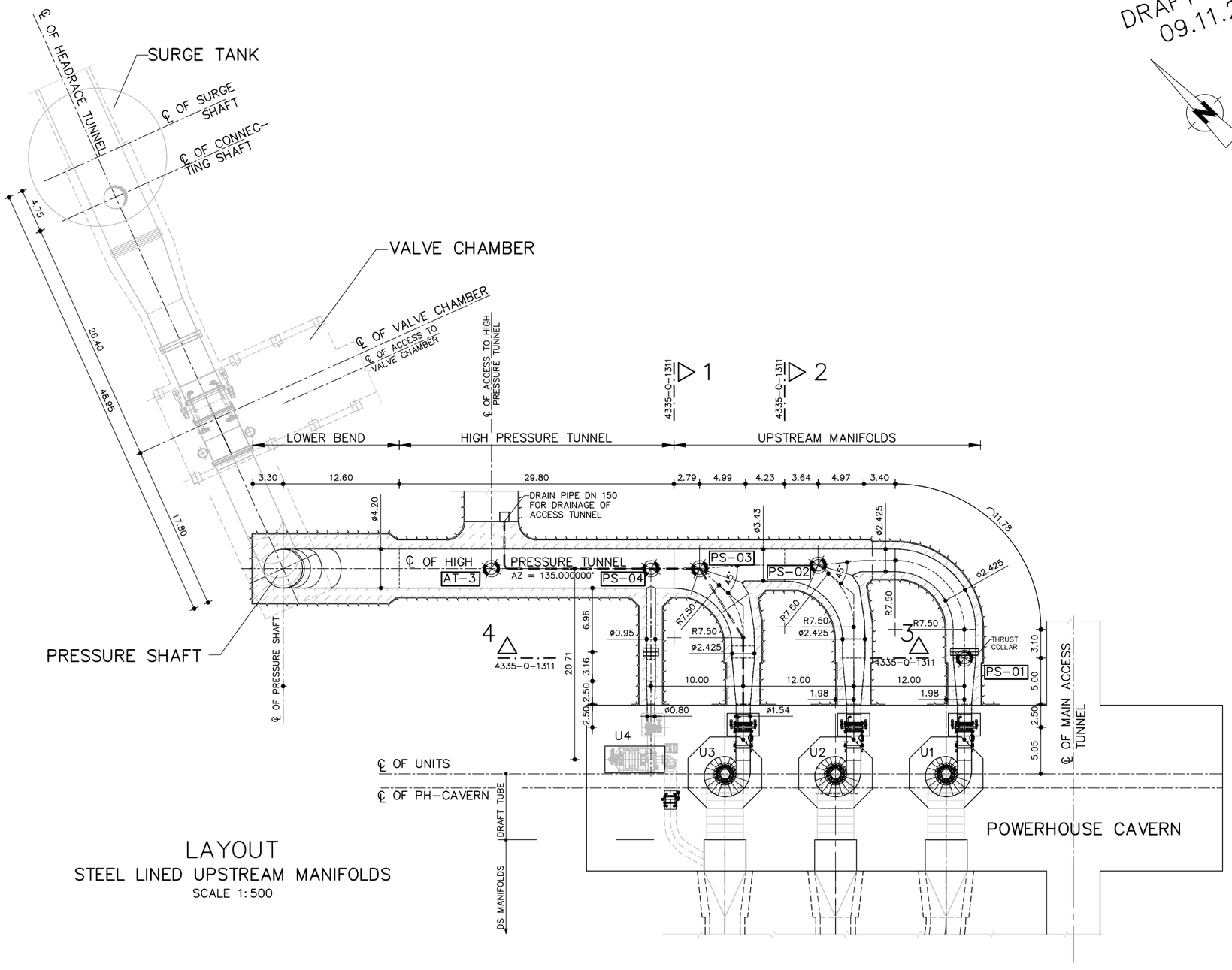
UPSTREAM POWER WATERWAYS

STEEL LINED HIGH PRESSURE TUNNEL

EXCAVATION AND ROCK SUPPORT

PROJECT DRAWING

Drwg. No.: 31–00053–DD–4330– S 1306 | REV. –



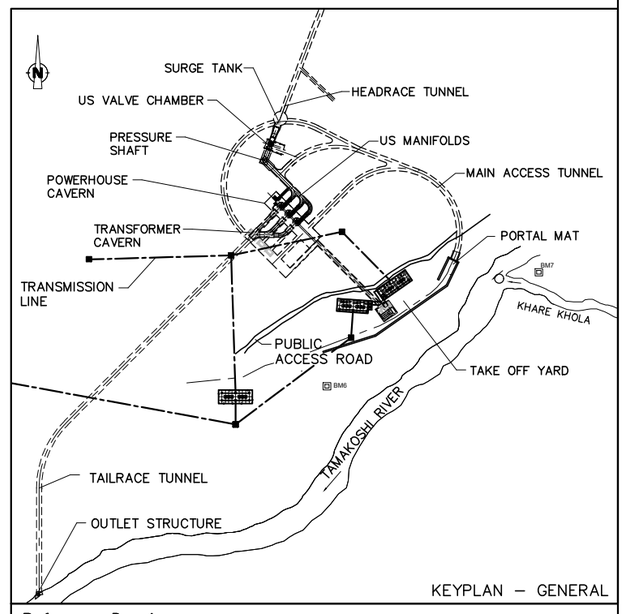
LAYOUT
STEEL LINED UPSTREAM MANIFOLDS
SCALE 1:500

DRAFT STATUS:
09.11.2018

NOTES:
1. ALL DIMENSIONS ARE IN METERS [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO-ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).

LEGEND:
- CONCRETE CLASS A – BACKFILL CONCRETE C20/25
- ⊕ ▽ UNFINISHED TOP OF SLAB
- ⊕ ▼ FINISHED FLOOR LEVEL

SCALE 1:500
−5 0 5 10 15 20 25 [m]



KEYPLAN – GENERAL

Reference Drawings

Drwg. No.	Title
31-00053-DD-4330-Q-1300	UPSTREAM POWER WATERWAYS, HIGH PRESSURE TUNNEL, LAYOUT

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	23.10.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

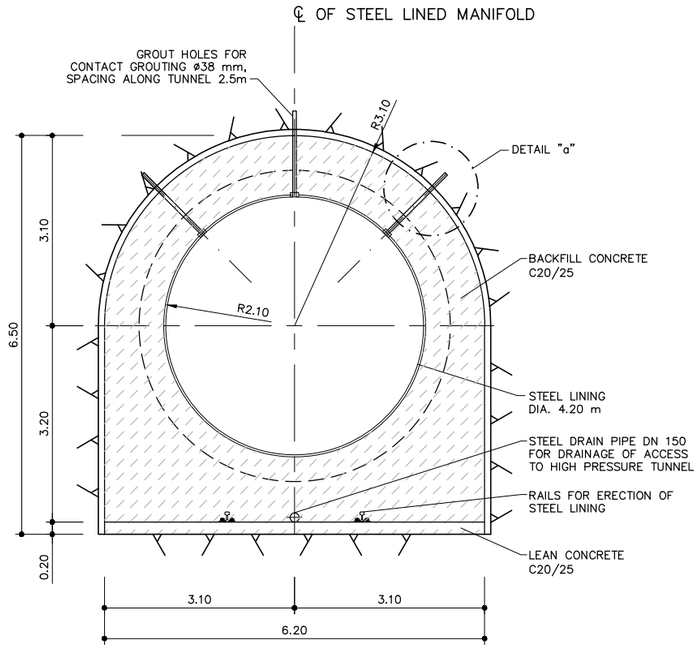
Replaces Drwg. No:
...

CAD- File No.:

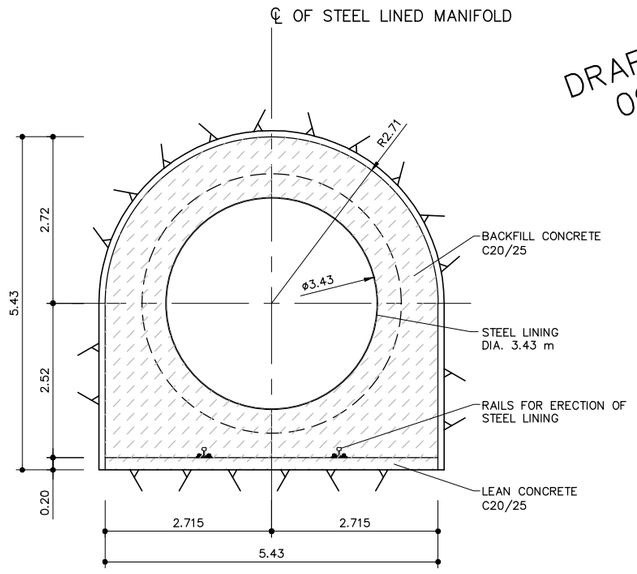
Scale A3: 1:500

DETAILED DESIGN
UPSTREAM POWER WATERWAYS
UPSTREAM MANIFOLDS
LAYOUT
PROJECT DRAWING

Drwg. No.: 31-00053-DD-4335-Q 1310 REV. –



SECTION 1–1
BIFURCATION–CHAMBER 1



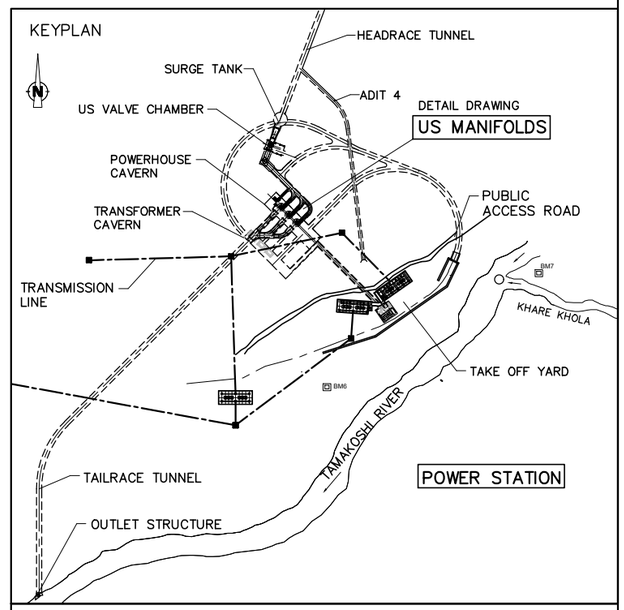
SECTION 2–2
BIFURCATION–CHAMBER 2

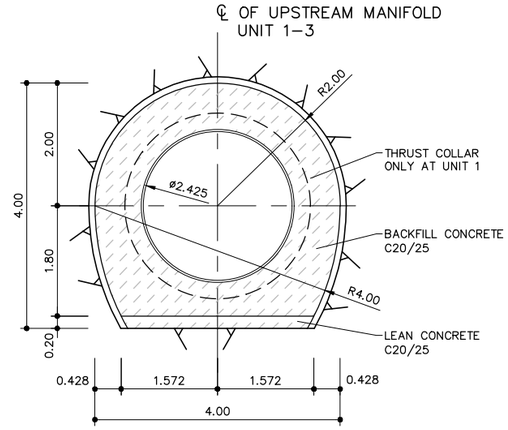
DRAFT STATUS:
09.11.2018

NOTES:

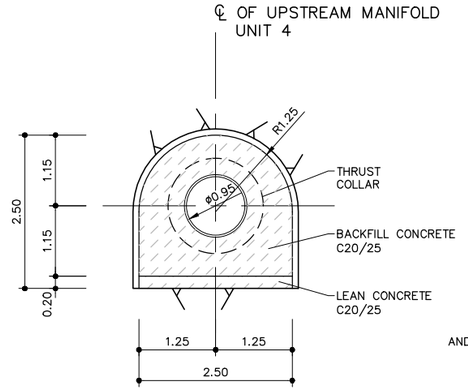
1. ALL DIMENSIONS ARE IN METER [m] UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE ABOVE SEA LEVEL IN [masl].
3. CO–ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).
4. EXTERNAL DIMENSIONS REFER TO THE SHOTCRETE LINE = THE CLEAR PROFILE OF THE STRUCTURE. THE EXCAVATION LINE HAS TO BE ADJUSTED ACCORDING TO THE ACTUAL GEOLOGICAL CONDITIONS.
5. ROCK SUPPORT MEASURES NOT SHOWN.
6. RAILS AS SHOWN FOR ERECTION OF STEEL LINING ONLY FOR INDICATIVE PURPOSE AND ARRANGEMENT WILL DEPEND ON CONTRACTORS ERECTION METHODOLOGY.

SCALE 1:100
–1 0 1 2 3 4 5 [m]

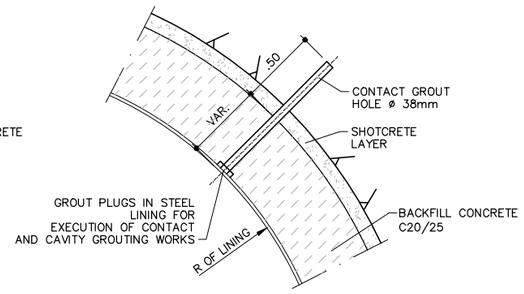




SECTION 3–3
MANIFOLD 1–3
TYPICAL SECTION



SECTION 4–4
MANIFOLD No. 4



DETAIL "a"
US STEEL LINED MANIFOLD
SCALE 1:10

LEGEND:

▨ CONCRETE CLASS A – BACKFILL CONCRETE C20/25

⊗ FIXPOINT–COORDINATE

Reference Drawings

Drwg. No.	Title
31–00053–DD–4335–Q–1310	UPSTREAM POWER WATERWAYS, US MANIFOLDS, LAYOUT

Revisions

	Name	Date	Notes

TAMAKOSHI V HYDROELECTRIC PROJECT
PROJECT DEVELOPMENT DEPARTMENT
ENGINEERING SERVICES DIRECTORATE
NEPAL ELECTRICITY AUTHORITY

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS
BAD VILBEL, GERMANY

TAMAKOSHI V HYDROELECTRIC PROJECT
DETAILED ENGINEERING DESIGN

	Name	Date
Prepared	B. Khadka	23.10.17
Drawn	B. Khadka	
Checked	Roloff	
Approved	Dr. Moeller	

Replaces Drwg. No:
...

CAD– File No.:

DETAILED DESIGN

UPSTREAM POWER WATERWAYS
UPSTREAM MANIFOLDS

SECTIONS
PROJECT DRAWING

Scale A3: 1:100, 1:10

Drwg. No.: 31–00053–DD–4335–Q 1311 REV. –